#### **COVER PAGE**

Document Date: July 14, 2008

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CHEMETCO 19C – SF/Tech

#### **VOLUME 4**

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Exhibit 8

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### EXHIBIT 8 PUBLIC VERSION

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EXEMPT DOCUMENT NO. 1 3 3

THE AGENCY HAS DETERMINED THIS DOCUMENT IS EXEMPT IN PART FROM PUBLIC DISCLOSURE

# EXEMPT IN PART DOCUMENT

FILE CATEGORY SF/TECH

DOCUMENT DATE 07-14-2008

## - AS INDICATED ON INDIVIDUAL PAGES PUBLIC RECORD CLAIMED EXEMPT - IN PART

Bridgeport Brass, Indianapolis, Indiana Materials Chemetco Purchased From

| Metal Code   | Metal Code Shipped Date   | Pounds         | Description                    | CDA Number       | Chemical Content |
|--|---|----------------|--------------------------------|------------------|------------------|
| 1100   |   |                |                                |                  |                  |
|  | 4/17/2000   | 348            | Alloy 110 W/Free fron          | C11000 with Iron | See Tab C11000   |
|  | Total Pounds:   | ds: 348        |                                |                  |                  |
| 1201   |   |                |                                |                  |                  |
|  | 1/30/1998   | 3,650          | Furnace Spill                  | C12000           | See Tab C12000   |
|  | Total Pounds:   | ds; 3,650      |                                |                  |                  |
| 1220   |   |                |                                |                  |                  |
|  | 1/27/1998   | 1,824          | Furnace Spill                  | C12200           | See Tab C12200   |
|  | Total Pounds:   | ds: 1,824      |                                |                  |                  |
| 1451   |   |                |                                |                  |                  |
|  | 1/22/1998   | 15,096         | 1 Fumace Stug                  | C14510           | See Tab C14510   |
|  | 11/24/1998  | 11,118         | 1 Alloy 1451 Furnace Spill     | C14510           | See Tab C14510   |
|  | 11/24/1998  | 7.940          | 1 Alloy 1451 Furnace Slug      | C14510           | See Tab C14510   |
|  | 12/16/1998  | 11,852         | 1 Box and 1 Spill              | C14510           | See Tab C14510   |
|  | 1/20/1999   | 33,184         | 11 Boxes of Mill Scrap         | C14510           | See Tab C14510   |
|  | 1/20/1999   | 33,440         | Mill Scrap                     | C14510           | See Tab C14510   |
|  | 5/19/1999   | 8              | 2000 Series Furnace Screenings | C14510           | See Tab C14510   |
| * Breakdown provided by ?<br>Monday, July 14, 2008 | * Breakdown provided by Mike Housson. GBC Metals, LLC.<br>Monday, July 14, 2008 | BC Metab, LLC. |                                | BIOKEN           | Page 1 of 47     |

Monday, July 14, 2008

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MAY 18 2011

Chemical Content

CDA Number

Description

Pounds

Metal Code Shipped Date

Total Pounds:

See Tab C14500

C14500 Off Analysis C14500 Off Analysis C14500 Off Analysis C14500 Off Analysis

See Tab C14500

See Tab C14500
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See Tab C14500
See Tab C14500

C14500 Off Analysis C14500 Off Analysis C14500 Off Analysis

C14500 Off Analysis

O.A. Scrap Cuts
O.A. Scrap Cuts
O.A. Scrap Cuts
O.A. Scrap Cuts

O.A. Cake Cuts O.A. 1450 Cuts O.A. 1450 Cuts

38.630 8,278 13,808 8,576 33,772 26,598 6,168

8/13/1997 12/12/1997 12/18/1997 12/18/1997 12/18/1997

145 Billet Cuts

16,048

4/19/1996

1458

C14500 Off Analysis C14500 Off Analysis C14500 Off Analysis C14500 Off Analysis C14500 Off Analysis

O.A. Scrap Cuts
O.A. Scrap Cuts
O.A. Scrap Cuts
O.A. Scrap Cuts

12/22/1997 12/22/1997 12/23/1997 12/29/1997 12/29/1998

836 21,662 3,936 13,080 C14500 Off Analysis C14500 Off Analysis

O A 145 Billet Cuts

7,404

Furnace Spill O.A. 145 Cuts O.A. 145 Cuts

C14500 Off Analysis C14500 Off Analysis

O.A. Scrap Cuts

2,324 15,596 8,344

> 3/18/1998 3/19/1998 12/16/1998

| See Tab C14500      |               | See Tab C19400    | See Tabs C19400, C36000 and C51000 |               |
|---------------------|---------------|-------------------|------------------------------------|---------------|
| C14500 Off Analysis |               | C19400 Tin Coated | C19400 + C36000 +<br>C51000 Mixed  |               |
| Spill               |               | Tinned 1940 Scrap | Mixed Bales (194/350/510)          |               |
| 4,272               | 229,836       | 100               | 4,534                              | 4,634         |
| 1/20/1999           | Total Pounds: | 11/21/1998        | 11/21/1998                         | Total Pounds: |
|                     |               | 1940              |                                    |               |

<sup>\*</sup> Breakdown provided by Mike Houston, GBC Metals, LLC.

Monday, July 14, 2008

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|------------|------------------|---------|------------------------------|--------------------------|----------------|
| 2100       |                  |         |                              |                          |                |
|            | 6/21/2000        | 15,370  | Alloy 210 Furnace Spill      | C21000                   | See Tab C21000 |
|            | Total Pounds:    | 15,370  |                              |                          |                |
| 2108       |                  |         |                              |                          |                |
|            | 11/21/1998       | 17,398  | 2100 Cake Cuts W/.102 Te     | C21000 with<br>Tellurium | See Tab C21000 |
|            | 12/16/1998       | 1,678   | 1 Spill                      | C21000 Off Analysis      | See Tab C21000 |
|            | 8/31/1999        | 37,816  | 5 Boxes OA 210 Cake Cuts     | C21000 Off Analysis      | See Tab C21000 |
|            | 8/9/1999         | 8,338   | 2 Boxes OA 210 Cake Cuts     | C21000 Off Analysis      | See Tab C21000 |
|            | 9/14/1999        | 11,570  | OA 210 Cake Cuts             | C21000 Off Analysis      | See Tab C21000 |
|            | 11/14/2000       | 350     | Spill W/ FE                  | C21000 with Iron         | See Tab C21000 |
|            | 12/28/2000       | 14,360  | O.A. Cuts W// .17 SN & .3 SI | C21000 Off Analysis      | See Tab C21000 |
|            | 1/8/2001         | 9,120   | O.A. Cuts (1.75 SN; 65 SI)   | C21000 Off Analysis      | See Tab C21000 |
|            | 3/12/2001        | 8,652   | Alloy 210 Coit W/ .074 Ti    | C21000 Off Analysis      | See Tab C21000 |
|            | 3/14/2001        | 1,226   | Slug W/FE                    | C21000 with Iron         | See Tab C21000 |
|            | Total Pounds:    | 110,508 |                              |                          |                |
| 2200       |                  |         |                              |                          |                |
|            | 12/16/1998       | 2,274   | 1 Spill                      | C22000                   | See Tab C22000 |
|            | 11/17/1999       | 9,700   | OA 220 Cake Cuts             | C22000 Off Analysis      | See Tab C22000 |
|            | Total Pounds:    | 11,974  |                              |                          |                |
| 2204       |                  |         |                              |                          |                |
|            | 7/12/2000        | 13,280  | Spill                        | C22000                   | See Tab C22000 |
|            | Total Pounds:    | 13,280  |                              |                          |                |
| 2208       |                  |         |                              |                          | •              |
|            | 9/28/2000        | 21,002  | O.A. Cake Cuts W/ 1.58% FE   | C22000 with Iron         | See Tab C22000 |

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|-----------|--------------------------|--------|---|------------------|-----------------|
|           | 12/28/2000               | 16,728 | D.A. Cuts W/, 15 FE   | C22000 with Iron | See Tab C22000  |
|           | 1/8/2001                 | 6,626  | O.A. Cuts (.15 FE)  | C22000 with Iron | See Tab C22000  |
|           | 1/31/2001                | 6,326  | O.A. Cuts W/.696 FE   | C22000 with Iron | See Tab C22000  |
|           | 2/1/2001                 | 7,894  | 1 Spill W/FE  | C22000 with fron | See Tab C22000  |
|           | 3/14/2001                | 6,646  | Slug W/FE   | C22000 with Iron | See Tab C22000  |
|           | 5/21/2001                | 8,484  | O.A. Cuts W/, 889 FE  | C22000 with Iron | See Tab C22000  |
|           | 5/22/2001                | 10,712 | O.A. Cuts W/.889 FE   | C22000 with Iron | See Tab C22000  |
|           | Total Pounds:            | 84,418 |   |                  |                 |
| 2300      |                          |        |   |                  |                 |
|           | 3/20/1998                | 3,308  | 1 Furnace Spill   | C23000           | See Tab C23000  |
|           | Total Pounds:            | 3,308  |   |                  |                 |
| 2308      |                          |        |   |                  |                 |
|           | 9/28/2000                | 7,574  | O.A. Cake Cuts W/ 1.05% FE  | C23000 with Iron | See Tab C23000  |
|           | 9/29/2000                | 6,056  | O.A. Cake Cuts W/ 1.05% FE  | C23000 with fron | See Tab C23000  |
|           | Total Pounds:            | 13,630 |   |                  |                 |
| 2400      |                          |        |   |                  | ·               |
|           | 5/19/1999                | 8,316  |   | C24000           | See Tab C24000  |
|           | Total Pounds:            | 8,316  |   |                  |                 |
| 2600      |                          |        |   |                  |                 |
|           | 4/8/1998                 | 33,260 | Source Document is Casting Receipts & Shipments by Content printout for 4/8/1998; no invoice available  | C25000           | See Tab C26000  |
|           | 10/8/1998                | 42,570 | Source Document is Casting Receipts & Shipments by Content printout for 10/8/1998; no invoice available | C25000           | See Tab C26000  |
|           | 12/16/1998               | 960'9  | 1 Spill   | C26000           | See Tab C26000  |

\* Breatdown provided by Mike Houston, GBC Metals, LLC.

|      | 9/10/1999     | 2,902  | 1 Fumace Spill                    | C25000              | See Tab C26000 |
|------|---------------|--------|-----------------------------------|---------------------|----------------|
|      | Total Pounds: | 84,828 |                                   |                     |                |
| 2608 |               |        |                                   |                     |                |
|      | 3/20/1998     | 10,636 | 1 Fumace Spill                    | C26000 Off Analysis | See Tab C26000 |
|      | 5/19/1999     | 3,850  |                                   | C26000 Off Analysis | See Tab C26000 |
|      | 5/19/1999     | 5,464  |                                   | C26000 Off Analysis | See Tab C26000 |
|      | 8/9/1998      | 11,062 | 4 Spills                          | C26000 Off Analysis | See Tab C26000 |
|      | 10/20/1999    | 5,214  | Fumace Spill                      | C26000 Off Analysis | See Tab C26000 |
|      | 2/22/2000     | 1,948  | 2 Furnace Spills W/FE - Alloy 260 | C26000 with Iron    | See Tab C26000 |
|      | 7/12/2000     | 1,406  | Hids                              | C26000 Off Analysis | See Tab C26000 |
|      | 11/14/2000    | 322    | Spill W/ FE                       | C26000 with Iron    | See Tab C26000 |
|      | 12/8/2000     | 1,278  | Spill W/ FE                       | C26000 with Iron    | See Tab C26000 |
|      | 1/15/2001     | 20,044 | Spills                            | C26000 Off Analysis | See Tab C26000 |
|      | 2/1/2001      | 15,902 | 3 Spills W/FE                     | C26000 with Iron    | See Tab C26000 |
|      | 3/12/2001     | 856    | Funace Spill W/ FE                | C26000 with Iron    | See Tab C26000 |
|      | 3/14/2001     | 474    | Slug W/FE                         | C26000 with Iron    | See Tab C26000 |
|      | 5/21/2001     | 4,204  | Spill W/FE                        | C26000 with Iron    | See Tab C26000 |
|      | Total Pounds: | 82,660 |                                   |                     |                |
| 3140 |               |        |                                   |                     |                |
|      | 1/27/1998     | 1,336  | Furnace Spill                     | C31400              | See Tab C31400 |
|      | 8/25/1999     | 3,370  | 1 Box Alloy 314 Mill Scrap        | C31400              | See Tab C31400 |
|      | 8/31/1999     | 714    | 2 Boxes Alloy 314 Mill Scrap      | C31400              | See Tab C31400 |
|      | Total Pounds: | 5,420  |                                   |                     |                |
| 3148 |               |        |                                   |                     |                |
|      | 12/19/1997    | 4,814  | O.A. Scrap Cuts                   | C31400 Off Analysis | See Tab C31400 |

<sup>\*</sup> Breakdown provided by Mike Housion, GBC Metals, LLC.

| 1,202/1997   1,3659   O.A. Scrap Cuts   C.31400 Of Analysis   See Tab C.31400   Founds: 1,2621/1997   1,3659   O.A. Scrap Cuts   C.31400 Of Analysis   See Tab C.31400   | Metal Code | Metal Code Shipped Date | Pounds | Description                    | CDA Number          | Chemical Content                                      |
|--|------------|-------------------------|--------|--------------------------------|---------------------|---|
| 12023/1997         3,854         O.A. Scrap Cuts         C31400 Off Analysis           Total Pounds:         22,435         22 Boxes Alloy 3300 Mill Scrap         C33000           8/19/1999         2,990         4 Boxes Alloy 3300 Mill Scrap         C33000           7 Total Pounds:         10,878         7 Boxes Alloy 3320 Mill Scrap         C33200           7 Total Pounds:         10,878         7 Boxes Alloy 3350 Mill Scrap         C33200           7 Total Pounds:         6,058         5 Boxes Alloy 344 Mill Scrap         C34500           7 Total Pounds:         2,552         2 Boxes Alloy 345 Mill Scrap         C34500           7 Total Pounds:         1,272         1 Furnace Spill         C34500           9/25/1999         1,272         1 Furnace Spill         C34500           10/4/1999         1,372         1 Furnace Spill         C34500           10/4/1999         1,372         1 Furnace Spill Carls         C34500           10/4/1999         1,373         1 Furnace Spill Carls         C34500           10/4/1999         1,373         1 Say Bilet Carls         C34500 |            | 12/22/1997              | 13,668 | O.A. Scrap Cuts                | C31400 Off Analysis | See Tab C31400  |
| Fotal Pounds:         22.438           8/13/1999         27,728         22 Boxes Alloy 3300 Mill Scrap         C33000           8/23/1999         2,990         4 Boxes Alloy 3300 Mill Scrap         C33000           8/23/1999         10,878         7 Boxes Alloy 3320 Mill Scrap         C33200           7 otal Pounds:         6,058         5 Boxes Alloy 335 Mill Scrap         C33500           7 otal Pounds:         6,058         5 Boxes Alloy 344 Mill Scrap         C34400           8/25/1999         2,552         2 Boxes Alloy 345 Mill Scrap         C34500           7 otal Pounds:         1,272         1 Fumace Spill         C34500           9/25/1999         10,168         7 Boxes Alloy 345 Mill Scrap         C34500           7 otal Pounds:         1,572         1 Fumace Spill         C34500           10/4/1999         1,590         Excess Mill Scrap         C34500           7 otal Pounds:         1,590         Excess Mill Scrap         C34500   |            | 12/23/1997              | 3,954  | O.A. Scrap Cuts                | C31400 Off Analysis | See Tab C31400  |
| 8/19/1999         27,728         2.2 Boxes Alloy 3300 Mill Scrap         C33000           8/23/1999         2,990         4 Boxes Alloy 3300 Mill Scrap         C33000           701al Pounds:         10,878         7 Boxes Alloy 3320 Mill Scrap         C33200           701al Pounds:         10,878         5 Boxes Alloy 335 Mill Scrap         C33500           701al Pounds:         6,058         5 Boxes Alloy 344 Mill Scrap         C34400           8/25/1999         2,552         2 Boxes Alloy 345 Mill Scrap         C34500           701al Pounds:         2,552         1 Funnace Spill         C34500           8/25/1999         1,272         1 Funnace Spill         C34500           104/1999         1,390         Excess Mill Scrap         C34500           104/1999         1,890         Excess Mill Scrap         C34500           104/1999         1,890         Excess Mill Scrap         C34500           104/1999         13.33 Billet Cuts         C35300 CH Analysis  |            | Total Pounds:           |        |                                |                     |   |
| 8/12/1999         27,728         22 Boxes Alloy 3300 Mill Scrap         C33000           8/23/1999         2,990         4 Boxes Alloy 3300 Mill Scrap         C33000           701al Pounds:         10,878         7 Boxes Alloy 3320 Mill Scrap         C33500           701al Pounds:         6,058         5 Boxes Alloy 335 Mill Scrap         C33500           701al Pounds:         6,058         5 Boxes Alloy 344 Mill Scrap         C34400           8/25/1999         2,552         2 Boxes Alloy 345 Mill Scrap         C34500           701al Pounds:         2,552         2 Boxes Alloy 345 Mill Scrap         C34500           8/25/1999         1,272         1 Furnace Spill         C34500           104/1999         1,372         1 Furnace Spill         C34500           104/1999         1,372         1 Furnace Spill         C34500           104/1999         1,390         Excess Mill Scrap         C34500           104/1999         13,390         Excess Mill Scrap         C34500  | 3300       |                         |        |                                |                     |   |
| 8/23/1999         2,990         4 Boxess Alloy 3300 Mill Scrap         C33000           Total Pounds:         10,878         7 Boxes Alloy 3320 Mill Scrap         C33200           Total Pounds:         6,058         6 Boxes Alloy 335 Mill Scrap         C33500           Total Pounds:         6,058         2 Boxes Alloy 344 Mill Scrap         C33500           Total Pounds:         2,552         2 Boxes Alloy 344 Mill Scrap         C34400           3/20/1998         1,272         1 Funnace Spill         C34500           10/4/1999         10,168         7 Boxes Alloy 345 Mill Scrap         C34500           Total Pounds:         1,280         Excess Mill Scrap         C34500           Total Pounds:         13,130         Excess Mill Scrap         C34500           Total Pounds:         13,130         Excess Mill Scrap         C3500 Off Analysis   |            | 8/19/1999               | 27,728 | 22 Boxes Alloy 3300 Mill Scrap | C33000              | See Tab C33000  |
| Total Pounds:       30,718       7 Boxes Alloy 3320 Mill Scrap       C33200         8/23/1999       10,878       7 Boxes Alloy 3320 Mill Scrap       C33500         7 total Pounds:       6,058       5 Boxes Alloy 335 Mill Scrap       C33500         8/25/1999       2,552       2 Boxes Alloy 344 Mill Scrap       C34400         7 total Pounds:       1,272       1 Furnace Spill       C34500         8/25/1999       1,272       1 Furnace Spill       C34500         10/4/1999       1,590       Excess Mill Scrap       C34500         Total Pounds:       13,130       Excess Mill Scrap       C33500 Off Analysis  |            | 8/23/1999               | 2,990  | 4 Boxes Alloy 3300 Mill Scrap  | C33000              | See Tab C33000  |
| 8/23/1999         10,878         7 Boxes Alloy 3320 Mill Scrap         CG33200           Total Pounds:         10,878         5 Boxes Alloy 335 Mill Scrap         CG3500           Total Pounds:         6,058         5 Boxes Alloy 344 Mill Scrap         CG3400           8/25/1999         2,552         2 Boxes Alloy 344 Mill Scrap         CG3400           70tal Pounds:         2,552         2 Boxes Alloy 345 Mill Scrap         CG34500           8/25/1999         1,272         1 Furnace Spill         CG34500           8/25/1999         1,0168         7 Boxes Alloy 345 Mill Scrap         CG34500           10/4/1999         1,690         Excess Mill Scrap         CG34500           70ial Pounds:         13,130         CG35300 CH Analysis  |            | Total Pounds:           |        |                                |                     |   |
| 8/23/1999         10,878         7 Boxes Alloy 3320 Mill Scrap         C33200           Total Pounds:         6,058         5 Boxes Alloy 335 Mill Scrap         C33500           R/25/1999         2,552         2 Boxes Alloy 344 Mill Scrap         C34400           Total Pounds:         2,552         2 Boxes Alloy 345 Mill Scrap         C34500           8/25/1999         1,272         1 Furnace Spiil         C34500           8/25/1999         1,272         1 Furnace Spiil         C34500           10/4/1999         1,272         1 Furnace Spiil         C34500           10/4/1999         1,272         1 Furnace Spiil         C34500           10/4/1999         1,273         1 Furnace Spiil         C34500           10/4/1999         1,590         Excess Mill Scrap         C34500           Total Pounds:         13,130         Excess Mill Scrap         C35300 Off Analysis   | 3320       |                         |        |                                |                     |   |
| Total Pounds:       10,878       5 Boxes Alloy 335 Mill Scrap       C33500         4/25/1999       6,058       5 Boxes Alloy 344 Mill Scrap       C34400         Total Pounds:       2,552       2 Boxes Alloy 345 Mill Scrap       C34400         Total Pounds:       1,272       1 Furnace Spill       C34500         8/25/1999       1,272       1 Furnace Spill       C34500         10/4/1999       1,590       Excess Mill Scrap       C34500         Total Pounds:       13,130       Excess Mill Scrap       C35300 CH Analysis  |            | 8/23/1999               | 10,878 | 7 Boxes Alloy 3320 Mill Scrap  | C33200              | See Tab C33200  |
| 4/25/1999       6,058       5 Boxes Alloy 335 Mill Scrap       C33500         Total Pounds:       6,058       2,552       2 Boxes Alloy 344 Mill Scrap       C34400         3/20/1999       1,272       1 Furnace Spill       C34500         8/25/1999       10,168       7 Boxes Alloy 345 Mill Scrap       C34500         104/1999       1,690       Excess Mill Scrap       C34500         Total Pounds:       13,130       C353 Billet Cuts       C35300 Off Analysis  |            | Total Pounds:           |        |                                |                     |   |
| 8/25/1999         6,058         5 Boxes Alloy 335 Mill Scrap         C33500           Total Pounds:         6,058         2 Boxes Alloy 344 Mill Scrap         C34400           Total Pounds:         2,552         2 Boxes Alloy 345 Mill Scrap         C34500           3/20/1998         1,272         1 Furnace Spill         C34500           8/25/1999         10,168         7 Boxes Alloy 345 Mill Scrap         C34500           10/4/1999         1,590         Excess Mill Scrap         C34500           Total Pounds:         13,130         Excess Mill Scrap         C34500           4/19/1996         12,574         353 Billet Cuts         C35300 Off Analysis  | 3350       |                         |        |                                |                     |   |
| Total Pounds:       6,058       2,552       2 Boxes Alloy 344 Mill Scrap       C34400         Total Pounds:       2,552       2 Boxes Alloy 344 Mill Scrap       C34500         3/20/1998       1,272       1 Funace Spill       C34500         8/25/1999       10,168       7 Boxes Alloy 345 Mill Scrap       C34500         10/4/1999       1,690       Excess Mill Scrap       C34500         Total Pounds:       13,130       C35300 Off Analysis   |            | 8/25/1999               | 6,058  | 5 Boxes Alloy 335 Mill Scrap   | C33500              | See Tab C33500  |
| 8/25/1999       2,552       2 Boxes Alloy 344 Mill Scrap       C34400         Total Pounds:       2,552       1 Furnace Spill       C34500         3/20/1998       1,272       1 Furnace Spill       C34500         6/25/1999       10,468       7 Boxes Alloy 345 Mill Scrap       C34500         10/4/1999       1,590       Excess Mill Scrap       C34500         Total Pounds:       13,130       C35300 Off Analysis   |            | Total Pounds:           |        |                                |                     |   |
| 8/25/1999       2,552       2 Boxes Alloy 344 Mill Scrap       C34400         Total Pounds:       2,552       1 Eurnace Spill       C34500         8/25/1998       10,168       7 Boxes Alloy 345 Mill Scrap       C34500         10/4/1999       1,690       Excess Mill Scrap       C34500         Total Pounds:       13,130       A/19/1996       12,874       353 Billet Cuts   | 3440       |                         |        |                                |                     |   |
| Total Pounds:       2,552         3/20/1998       1,272       1 Furnace Spill       C34500         8/25/1999       10,168       7 Boxes Alloy 345 Mill Scrap       C34500         10/4/1999       1,690       Excess Mill Scrap       C34500         Total Pounds:       13,130       C35300 Off Analysis  |            | 8/25/1999               | 2,552  | 2 Boxes Alloy 344 Mill Scrap   | C34400              | 62.0 - 86.0% Cu/.50 - 1.0% Pb/.10%<br>Fe/Remainder Zn |
| 3/20/1998       1,272       1 Furnace Spill       C34500         8/25/1999       10,168       7 Boxes Alloy 345 Mill Scrap       C34500         10/4/1999       1,690       Excess Mill Scrap       C34500         7otal Pounds:       13,130       C35300 Off Analysis  |            | Total Pounds:           |        |                                |                     |   |
| 3/20/1998       1,272       1 Furnace Spiti       C34500         8/25/1999       10,168       7 Boxes Alloy 345 Mill Scrap       C34500         10/4/1999       1,690       Excess Mill Scrap       C34500         Total Pounds:       13,130       C35300 Off Analysis  | 3450       |                         |        |                                |                     |   |
| 6/25/1999       10,168       7 Boxes Alloy 345 Mill Scrap       C34500         10/4/1999       1,690       Excess Mill Scrap       C34500         Total Pounds:       13,130       13,130         4/19/1996       12,674       353 Billet Cuts       C35300 Off Analysis   |            | 3/20/1998               | 1,272  | 1 Furnace Spill                | C34500              | See Tab C34500  |
| 10/4/1999         1,690         Excess Mill Scrap         C34500           Total Pounds:         13,130         13,130           4/19/1996         12,674         353 Billet Cuts         C35300 Off Analysis  |            | 8/25/1999               | 10,168 | 7 Boxes Alloy 345 Mill Scrap   | C34500              | See Tab C34500  |
| Total Pounds:       13.130         4/19/1996       12,674       353 Billet Cuts  |            | 10/4/1999               | 1.690  | Excess Mill Scrap              | C34500              | See Tab C34500  |
| 4/19/1996 12,674 353 Billet Cuts C35300 Off Analysis   |            | Total Pounds:           |        |                                |                     |   |
| 12,674 353 Billet Cuts C35300 Off Analysis   | 3538       |                         |        |                                |                     |   |
|  |            | 4/19/1996               | 12,674 | 353 Billet Cuts                | C35300 Off Analysis | See Tab C35300  |

| Metal Code | Shipped Date  | Pounds  | Description                         | CDA Number          | Chemical Content |
|------------|---------------|---------|-------------------------------------|---------------------|------------------|
|            | 8/13/1997     | 38,370  | O.A. Cake Cuts                      | C35300 Off Analysis | See Tab C35300   |
|            | 9/23/1997     | 40,122  | O.A. 3530 Scrap                     | C35300 Off Analysis | See Tab C35300   |
|            | 11/25/1997    | 36,758  | O.A. 3530 Scrap                     | C35300 Off Analysis | See Tab C35300   |
|            | 3/17/1998     | 36,832  | O.A. 353 Cuts                       | C35300 Off Analysis | See Tab C35300   |
|            | 3/18/1998     | 23,162  | O.A. 353 Cuts                       | C35300 Off Analysis | See Tab C35300   |
|            | 3/19/1998     | 20,060  | O.A. 353 Cuts                       | C35300 Off Analysis | See Tab C35300   |
|            | 6/4/1999      | 38,886  | Off Analysis 353 Cake Cuts          | C35300 Off Analysis | See Tab C35300   |
|            | 11/17/1999    | 6,302   | OA 353 Cake Cuts                    | C35300 Off Analysis | See Tab C35300   |
|            | 11/17/1999    | 7,374   | OA 353 Cake Cuts                    | C35300 Off Analysis | See Tab C35300   |
|            | 11/14/2000    | 4,494   | Spill W/ FE                         | C35300 with Iron    | See Tab C35300   |
|            | 1/23/2001     | 5,358   | 2 Spills W/FE                       | C35300 with Iron    | See Tab C35300   |
|            | Total Pounds: | 270,392 |                                     |                     |                  |
| 3600       |               |         |                                     |                     |                  |
|            | 4/19/1996     | 6,256   | 3608 Billet Cuts                    | C36000              | See Tab C36000   |
|            | 8/23/1999     | 17,446  | 6 Boxes Alloy 3600 Mill Scrap       | C36000              | See Tab C36000   |
|            | 8/25/1999     | 10,080  | 2 Boxes Alloy 360 Mill Scrap        | C36000              | See Tab C38000   |
|            | Total Pounds: | 33,782  |                                     |                     |                  |
| 3608       |               |         |                                     |                     |                  |
|            | 3/20/1998     | 3,758   | 2 Furnace Spill                     | C36000 Off Analysis | See Tab C36000   |
|            | 3/26/1998     | 6,014   | 3608 O.A. Cuts                      | C36000 Off Analysis | See Tab C36000   |
|            | 5/19/1999     | 8,418   |                                     | C36000 Off Analysis | See Tab C36000   |
|            | - 8/16/2001   | 6,642   | Mixed Alloys W/ Staples, 100 MTL, 9 | C36000 Off Analysis | See Tab C36000   |
|            | Total Pounds: | 24,832  |                                     |                     |                  |
| 3770       |               |         |                                     |                     |                  |
|            | 3/19/1998     | 8,136   | O.A. 377 Cuts                       | C37700 Off Analysis | See Tab C37700   |
|            |               |         |                                     |                     |                  |

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|      | 3/20/1998     | 16,548 | O.A. 377 Cuts              | C37700 Off Analysis | See Tab C37700 |
|------|---------------|--------|----------------------------|---------------------|----------------|
|      | 3/23/1998     | 12,864 | 3778 O.A. Cuts             | C37700 Off Analysis | See Tab C37700 |
|      | 3/26/1998     | 6,822  | 3778 O.A. Cuts             | C37700 Off Analysis | See Tab C37700 |
|      | Total Pounds: | 44,368 |                            | -                   |                |
| 4118 |               |        |                            |                     |                |
|      | 12/18/1997    | 8,218  | O.A. Scrap Cuts            | C41100 Off Analysis | See Tab C41100 |
|      | 12/17/1998    | 2,508  | Furnace Spill              | C41100 Off Analysis | See Tab C41100 |
|      | 1/27/1999     | 10,188 | Mill Scrap                 | C41100 Off Analysis | See Tab C41100 |
|      | 2/8/1999      | 40,216 | O A Cake Cuts              | C41100 Off Analysis | See Tab C41100 |
|      | 3/8/1999      | 14,080 | O A 4110 Scrap             | C41100 Off Analysis | See Tab C41100 |
|      | 10/5/1999     | 5,822  | OA Cake Cuts W/. 3% FE     | C41100 with Iron    | See Tab C41100 |
|      | 7/12/2000     | 11,654 | Spiit                      | C41100 Off Analysis | See Tab C41100 |
|      | Total Pounds: | 92,684 |                            |                     |                |
| 4220 |               |        |                            |                     |                |
|      | 11/21/1998    | 2,500  | 1 4220 Spil W/Fe AND DIRT  | C42200 with fron    | See Tab C42200 |
|      | 11/24/1998    | 14,966 | 1 Alloy 4220 Furnace Spill | C42200 Off Analysis | See Tab C42200 |
|      | Total Pounds: | 17,466 |                            |                     |                |
| 4228 |               |        |                            |                     |                |
|      | 1/26/1998     | 3,300  | 1 Furnace Spill            | C42200 Off Analysis | See Tab C42200 |
|      | 10/5/1999     | 11,414 | OA Cake Cuts W/ 2.2% FE    | C42200 with Iron    | See Tab C42200 |
|      | 3/12/2001     | 8,634  | Furnace Slug               | C42200 Off Analysis | See Tab C42200 |
|      | 5/21/2001     | 11,832 | O.A. Cuts W/ .3439 PB      | C42200 Off Analysis | See Tab C42200 |
|      | Total Pounds: | 35,180 |                            |                     |                |
| 4430 |               |        |                            |                     |                |

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|-----------|--------------------------|---------|----------------------|---------------------|----------------|
|           | 11/30/1998               | 3,798   | 1 Fumace Spill       | C44300              | See Tab C44300 |
|           | Total Pounds:            | 3,798   |                      |                     |                |
| 4438      |                          |         |                      |                     |                |
|           | 3/23/1998                | 10,840  | 4438 O.A. Cuts       | C44300 Off Analysis | See Tab C44300 |
|           | 3/26/1998                | 7,398   | 4438 O.A. Cuts       | C44300 Off Analysis | See Tab C44300 |
|           | 12/30/1998               | 99      | O.A. Cuts            | C44300 Off Analysis | See Tab C44300 |
|           | 12/31/1998               | 2,458   | O.A. Cuts            | C44300 Off Analysis | See Tab C44300 |
|           | 3/12/2001                | 11,934  | O.A. Cuts W/ .195 PB | C44300 Off Analysis | See Tab C44300 |
|           | 3/12/2001                | 11,596  | O.A. Cuts W/ .1 PB   | C44300 Off Analysis | See Tab C44300 |
|           | Total Pounds:            | 44,890  |                      |                     |                |
| 4640      |                          |         |                      |                     |                |
| •         | 1/26/1998                | 8,574   | O.A. Cuts            | C46400 Off Analysis | See Tab C46400 |
|           | 2/11/1998                | 9,548   | O.A. 464 Cuts        | C46400 Off Analysis | See Tab C46400 |
|           | Total Pounds:            | 18,120  |                      |                     |                |
| 2108      |                          |         |                      |                     |                |
|           | 12/18/1997               | 8,522   | O.A. Scrap Cuts      | C51000 Off Analysis | See Tab C51000 |
|           | 12/18/1997               | 2,872   | O.A. Scrap Cuts      | C51000 Off Analysis | See Tab C51000 |
|           | 12/18/1997               | 11,052  | O.A. Scrap Cuts      | C51000 Off Analysis | See Tab C51000 |
|           | 12/19/1997               | 899     | O.A. Scrap Cuts      | C51000 Off Analysis | See Tab C51000 |
|           | 1/15/2001                | 6,968   | Spill                | C51000 Off Analysis | See Tab C51000 |
|           | 3/14/2001                | 17,544  | Slug W/ FE           | C51000 with Iron    | See Tab C51000 |
|           | 3/14/2001                | 930     | Slug W/ FE           | C51000 with Iron    | See Tab C51000 |
|           | Total Pounds:            | 48,556  |                      |                     |                |
|           |                          |         |                      |                     |                |

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|      | 12/29/1997    | 44 245  |                               |                     | See Tab C63400 |
|------|---------------|---------|-------------------------------|---------------------|----------------|
|      |               | ٠.<br>د | O.A. scrap cuts               | C63400 Off Analysis |                |
|      | 1/26/1998     | 2,202   | Furnace Spill                 | C63400 Off Analysis | See Tab C63400 |
|      | 1/27/1998     | 6,158   | Furnace Spill                 | C63400 Off Analysis | See Tab C63400 |
|      | 1/30/1998     | 11,370  | Fumace Spill                  | C63400 Off Analysis | See Tab C63400 |
|      | 12/30/1998    | 13,522  | O.A. Cuts                     | C63400 Off Analysis | See Tab C63400 |
|      | Total Pounds: | 44,592  |                               |                     |                |
| 9969 |               |         |                               |                     |                |
|      | 12/16/1998    | 196     | 1 Spill                       | C63600              | See Tab C63600 |
|      | Total Pounds: | 196     |                               |                     |                |
| 6368 |               |         |                               |                     |                |
|      | 12/29/1997    | 5,612   | O.A. Scrap Cuts               | C63600 Off Analysis | See Tab C63600 |
|      | 1/22/1998     | 5,598   | O.A. Billet Cuts              | C63600 Off Analysis | See Tab C63600 |
|      | Total Pounds: | 11,210  |                               |                     |                |
| 6420 |               |         |                               |                     |                |
|      | 12/28/1998    | 11,750  | O.A. Billet Cuts              | C64200 Off Analysis | See Tab C64200 |
|      | 1/21/1999     | 35,630  | Mill Scrap                    | C64200              | See Tab C64200 |
|      | 1/23/1899     | 12,874  | Mill Scrap                    | C64200              | See Tab C64200 |
|      | 5/19/1999     | 6,572   |                               | C64200              | See Tab C64200 |
|      | 7/15/1999     | 16,976  | 12' Rods Scrapped @ Carpenter | C64200              | See Tab C64200 |
|      | Total Pounds: | 83,802  |                               |                     |                |
| 6425 |               |         | -                             |                     | •              |
|      | 1/23/1999     | 15,892  | Mill Scrap                    | C64200              | See Tab C64200 |
|      | Total Pounds: | 15,892  |                               |                     |                |
| 6428 |               |         |                               |                     |                |

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|-------|---------------|-----------|------------------|---------------------|----------------|
|       | 12/11/1997    | 5,862     | O.A. 6428 Cuts   | C64200 Off Analysis | See Tab C64200 |
|       | 12/12/1997    | 19,318    | O.A. 6420 Cuts   | C64200 Off Analysis | See Tab C64200 |
|       | 12/12/1997    | 7,780     | O.A. 6420 Cuts   | C64200 Off Analysis | See Tab C64200 |
|       | 12/15/1997    | 13,926    | O.A. 6420 Cuts   | C64200 Off Analysis | See Tab C64200 |
|       | 12/15/1997    | 38,452    | O.A. 6420 Cuts   | C64200 Off Analysis | See Tab C64200 |
|       | 12/29/1997    | 2,886     | O.A. Scrap Cuts  | C64200 Off Analysis | See Tab C64200 |
|       | 1/30/1998     | 3,682     | Fumace Spill     | C64200 Off analysis | See Tab C64200 |
|       | 12/29/1998    | 9,298     | O.A. Billet Cuts | C64200 Off Analysis | See Tab C64200 |
|       | 12/29/1998    | 6,446     | O.A. Billet Cuts | C64200 Off Analysis | See Tab C64200 |
|       | 12/29/1998    | 6,102     | O.A. Billet Cuts | C64200 Off Analysis | See Tab C64200 |
|       | 12/29/1998    | 5,842     | O.A. Billet Cuts | C64200 Off Analysis | See Tab C64200 |
|       | 12/30/1998    | 5,694     | O.A. Cuts        | C64200 Off Analysis | See Tab C64200 |
|       | 12/30/1998    | 7,816     | O.A. Cuts        | C64200 Off Analysis | See Tab C64200 |
|       | 12/31/1998    | 640       | O.A. Cuts        | C64200 Off Analysis | See Tab C64200 |
|       | Total Pounds: | : 133,744 |                  |                     |                |
| 06490 |               |           |                  |                     |                |
|       | 12/12/1997    | 22,128    | O.A. 6468 Cuts   | C64900 Off Analysis | See Tab C64900 |
|       | 12/12/1997    | 20,228    | O.A. 6490 Cuts   | C64900 Off Analysis | See Tab C64900 |
|       | Total Pounds: | 42,356    |                  |                     |                |
| 6498  |               |           |                  |                     | ٠              |
|       | 12/18/1997    | 13,440    | O.A. Scrap Cuts  | C64900 Off Analysis | See Tab C64900 |
|       | 12/19/1897    | 22,190    | O.A. Scrap Cuts  | C64900 Off Analysis | See Tab C64900 |
|       | 12/19/1997    | 5,722     | O.A. Scrap Cuts  | C64900 Off Analysis | See Tab C64900 |
|       | 12/29/1997    | 1,642     | O.A. Scrap Cuts  | C64900 Off Analysis | See Tab C64900 |
|       | 1             |           |                  |                     |                |

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| Metal Code | Metal Code Shipped Date | Pounds    | Description      | CDA Number          | Chemical Content  |
|------------|-------------------------|-----------|------------------|---------------------|---|
| 6510       |                         |           |                  |                     |   |
|            | 12/28/1998              | 7,258     | O.A. Billet Cuts | C65100 Off Analysis | See Tab C65100  |
|            | 1/22/1999               | 21,872    | Mill Scrap       | C65100              | See Tab C65100  |
|            | 1/23/1999               | 34,178    | Mill Scrap       | C65100              | See Tab C65100  |
|            | 1/26/1999               | 212       | Mill Scrap       | C65100              | See Tab C65100  |
|            | 1/27/1999               | 16,122    | Mili Scrap       | C65100              | See Tab C65100  |
|            | 1/28/1999               | 31,026    | Mill Scrap       | C65100              | See Tab C65100  |
|            | 1/29/1999               | 4,820     | Mill Scrap       | C65100              | See Tab C65100  |
|            | 1/30/1999               | 15,834    | Mill Scrap       | C65100              | See Tab C65100  |
|            | 2/4/1999                | 5.854     | Casting Salvage  | C65100              | See Tab C65100  |
|            | 5/19/1999               | 2,344     |                  | C65100              | See Tab C65100  |
|            | Total Pounds:           | 139,520   |                  |                     |   |
| 8159       |                         |           |                  |                     |   |
|            | 12/28/1998              | 8,034     | O.A. Billet Cuts | C65100 Off Analysis | See Tab C65100  |
|            | 12/30/1998              | 5,226     | O.A. Cuts        | C65100 Off Analysis | See Tab C65100  |
|            | 12/31/1998              | 6,856     | O.A. Cuts        | C65100 Off Analysis | See Tab C65100  |
|            | Total Pounds:           | 20,116    |                  |                     |   |
| 6530       |                         |           |                  |                     |   |
|            | 1/28/1999               | 27,778    | Mill Scrap       | C65300              | Min 97.4% Cu (incl. Ag)/.05% Pb/.8% Fe/2.0 -<br>2.6% Si |
|            | 1/29/1999               | 1,474     | Mill Scrap       | C65300              | Min 97.4% Cu (incl. Ag)/.05% Pb/.8% Fe/2.0 -<br>2.6% Si |
|            | 1/30/1999               | 30,976    | Mill Scrap       | C65300              | Min 97.4% Cu (incl. Ag)/.05% Pb/.8% Fe/2.0 • 2.6% Si    |
|            | Total Pounds:           | 5: 60,228 |                  |                     |   |

6551

| Metal Code | Shipped Date  | Pounds  | Description               | CDA Number          | Chemical Content |
|------------|---------------|---------|---------------------------|---------------------|------------------|
|            | 1/26/1998     | 3,302   | Furnace Spill             | C65500              | See Tab C65500   |
|            | 1/25/1999     | 30,618  | Mill Scrap                | C65500              | See Tab C65500   |
|            | 1/25/1999     | 32,496  | Mill Scrap                | C65500              | See Tab C65500   |
|            | 1/25/1999     | 33,502  | Mill Scrap                | C65500              | See Tab C65500   |
|            | 1/26/1999     | 34,230  | Mill Scrap                | C65500              | See Tab C65500   |
|            | 1/26/1999     | 31,488  | Mill Scrap                | _ C65500            | See Tab C65500   |
|            | 1/27/1999     | 6,118   | Mill Scrap                | C65500              | See Tab C65500   |
|            | Total Pounds: | 171,754 |                           |                     |                  |
| 6558       |               |         |                           |                     |                  |
|            | 12/11/1997    | 34,322  | O.A. 6550 Cuts            | C65500 Off Analysis | See Tab C65500   |
|            | 12/15/1997    | 8,684   | O.A. 6550 Cuts            | C65500 Off Analysis | See Tab C65500   |
|            | 12/18/1997    | 398     | O.A. Scrap Cuts           | C65500 Off Analysis | See Tab C65500   |
|            | 12/18/1997    | 518     | O.A. Scrap Cuts           | C65500 Off Analysis | See Tab C65500   |
|            | 12/19/1997    | 6,938   | O.A. Scrap Cuts           | C65500 Off Analysis | See Tab C65500   |
|            | 3/23/1998     | 6,990   | 6558 O.A. Cuts            | C65500 Off Analysis | See Tab C65500   |
|            | 12/16/1998    | 2,706   | Tinned 655 Scrap          | C65500 Tin Coated   | See Tab C65500   |
|            | 12/28/1998    | 6,604   | O.A. Billet Cuts          | C65500 Off Analysis | See Tab C65500   |
|            | 1/22/1999     | 4,968   | O A 6550 Scrap            | C65500 Off Analysis | See Tab C65500   |
|            | 5/19/1999     | 208     |                           | C65500 Off Analysis | See Tab C65500   |
|            | 5/20/1999     | 10,518  | Tinned 6550 Scrap         | C65500 Tin Coated   | See ⊤ab C65500   |
|            | 9/9/1999      | 10,204  | 13 Boxes Tinned 655 Scrap | C65500 Tin Coated   | See Tab C65500   |
|            | 10/19/1999    | 7,324   | Tinned 655 Scrap          | C65500 Tin Coated   | See Tab C65500   |
|            | 10/20/1999    | 13,860  | Tinned 655 Scrap          | C65500 Tin Coated   | See Tab C65500   |
|            | 10/29/1999    | 5,132   | Tinned 655 Scrap          | C65500 Tin Coated   | See Tab C65500   |
|            | 11/15/1999    | 7,118   | Tinned 6550 Scrap         | C65500 Tin Coated   | See Tab C65500   |
|            | 2/15/2000     | 6,294   | Tinned 655 Scrap          | C65500 Tin Coated   | See Tab C65500   |

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|------------|---------------|---------|------------------------------|-------------------|----------------|
|            | 4/6/2000      | 11,118  | 11 Boxes of Tinned 655 Scrap | C65500 Tin Coated | See Tab C65500 |
|            | 5/24/2000     | 9,498   | Tinned 655 Slitter Scrap     | C65500 Tin Coated | See Tab C65500 |
|            | 5/30/2000     | 276     | Tinned 655 Scrap             | C65500 Tin Coated | See Tab C65500 |
|            | 6/20/2000     | 4,444   | Tinned 655 Slitter Scrap     | C65500 Tin Coated | See Tab C65500 |
|            | 7/12/2000     | 15,610  | Tinned 655 Scrap             | C65500 Tin Coated | See Tab C65500 |
|            | 7/12/2000     | 18,354  | Tinned 655 Scrap             | C65500 Tin Coated | See Tab C65500 |
|            | 9/28/2000     | 6,870   | Tinned 6550 Scrap            | C65500 Tin Coated | See Tab C65500 |
|            | 9/29/2000     | 11,970  | Tinned 6550 Scrap            | C65500 Tin Coated | See Tab C65500 |
|            | 10/19/2000    | 8,296   | Tinned 6550 Scrap            | C65500 Tin Coated | See Tab C65500 |
|            | 10/23/2000    | 2,637   | Tinned 6550 Scrap            | C65500 Tin Coated | See Tab C65500 |
|            | 10/25/2000    | 2,184   | Tinned 6550 Scrap            | C65500 Tin Coated | See Tab C65500 |
|            | 10/26/2000    | 404     | Tinned 6550 Scrap            | C65500 Tin Coated | See Tab C65500 |
|            | 11/14/2000    | 8,276   | Tinned 6550                  | C65500 Tin Coated | See Tab C65500 |
|            | 11/15/2000    | 6,264   | Tinned 6550                  | C65500 Tin Coated | See Tab C65500 |
|            | 1/5/2001      | 9,702   | Tinned 655                   | C65500 Tin Coated | See Tab C65500 |
|            | 4/18/2001     | 20,244  | Tinned 655                   | C65500 Tin Coated | See Tab C65500 |
|            | 4/26/2001     | 2,874   | Tinned 655                   | C65500 Tin Coated | See Tab C65500 |
|            | 5/8/2001      | 8,660   | Tinned 655                   | C65500 Tin Coated | See Tab C65500 |
|            | 7/17/2001     | 15,796  | Tinned 655                   | C65500 Tin Coated | See Tab C65500 |
|            | 7/19/2001     | 18,374  | Tinned 655                   | C65500 Tin Coated | See Tab C65500 |
|            | 8/16/2001     | 17,218  | Tinned 655                   | C65500 Tin Coated | See Tab C65500 |
|            | 9/14/2001     | 12,952  | Tinned Alloy 655             | C65500 Tin Coated | See Tab C65500 |
|            | Total Pounds: | 345,107 |                              |                   |                |
| 0959       |               |         |                              |                   |                |
|            | 1/29/1999     | 11,588  | Mill Scrap                   | C65600            | See Tab C65600 |
|            | 2/16/1999     | 400     |                              |                   |                |

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| Metal Code Shipped Date | Suppen Dute 1 Dunas |        |                  |                     |                |
|-------------------------|---------------------|--------|------------------|---------------------|----------------|
|                         | Total Pounds:       | 14,688 |                  |                     |                |
| 6730                    |                     |        |                  |                     |                |
|                         | 12/28/1998          | 4,774  | O.A. Billet Cuts | C67300 Off Analysis | See Tab C67300 |
|                         | Total Pounds:       | 4,774  |                  |                     |                |
| 6731                    |                     |        |                  |                     |                |
|                         | 5/19/1999           | 450    |                  | C67300              | See Tab C67300 |
|                         | Total Pounds:       | 450    |                  |                     | -              |
| 6738                    |                     |        |                  |                     |                |
|                         | 1/27/1998           | 24,044 | O.A. Cuts        | C67300 Off Analysis | See Tab C67300 |
|                         | 1/30/1998           | 19,058 | O.A. Cuts        | C67300 Off Analysis | See Tab C67300 |
|                         | 2/11/1998           | 21,656 | O.A. 673 Cuts    | C67300 Off Analysis | See Tab C67300 |
|                         | 2/19/1998           | 17,502 | O.A. 673 Cuts    | C67300 Off Analysis | See Tab C67300 |
|                         | 12/28/1998          | 7,062  | O.A. Billet Cuts | C67300 Off Analysis | See Tab C67300 |
|                         | 12/29/1998          | 3,536  | O.A. Billet Cuts | C67300 Off Analysis | See Tab C67300 |
|                         | Total Pounds:       | 92,858 |                  |                     | ٠              |
| 6750                    |                     |        |                  |                     | •              |
|                         | 5/19/1999           | 254    |                  | C67500              | See Tab C67500 |
|                         | Total Pounds:       | 254    |                  |                     |                |
| 0769                    |                     |        |                  |                     |                |
|                         | 1/26/1998           | 5,596  | Furnace Spill    | C69400              | See Tab C69400 |
|                         | 12/16/1998          | 2,926  | 1 Spill          | C69400              | See Tab C69400 |
|                         | 12/17/1898          | 5,284  | Mill Scrap       | C69400              | See Tab C69400 |
|                         | 12/17/1998          | 30,278 | Mill Scrap       | C69400              | See Tab C69400 |
|                         | 12/18/1098          | 30 A76 | Mill Soron       | 007000              | 007000 AFE 000 |

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|-----------|---------------|---------|--|---------------------|----------------|
|           | 12/21/1998    | 3,488   | Mill Scrap   | C69400              | See Tab C69400 |
|           | 12/28/1998    | 6,506   | O.A. Billet Cuts   | C69400 Off Analysis | See Tab C69400 |
|           | 12/28/1998    | 1,146   | O.A. Billet Cuts   | C69400 Off Analysis | See Tab C69400 |
|           | Total Pounds: | 87,650  |  |                     |                |
| 6943      |               |         |  |                     |                |
|           | 12/21/1998    | 22,284  | Milt Scrap   | C69430              | See Tab C69430 |
|           | 12/23/1998    | 25,990  | Mill Scrap   | C69430              | See Tab C69430 |
|           | Total Pounds: | 48,274  |  |                     |                |
| 6948      |               |         |  |                     |                |
|           | 12/19/1997    | 22,746  | O.A. Scrap Cuts  | C69400 Off Analysis | See Tab C69400 |
|           | 12/22/1997    | 11,836  | O.A. Scrap Cuts  | C69400 Off Analysis | See Tab C69400 |
|           | 12/23/1997    | 24,666  | O.A. Scrap Cuts  | C69400 Off Analysis | See Tab C69400 |
|           | 1/22/1998     | 17,194  | O.A. Billet Cuts   | C69400 Off Analysis | See Tab C69400 |
|           | 1/27/1998     | 1,606   | Fumace Spiil   | C69400 Off Analysis | See Tab C69400 |
|           | 12/16/1998    | 6,354   | O A 694 Billet Cuts  | C69400 Off Analysis | See Tab C69400 |
|           | 12/16/1998    | 18,984  | O A 694 Billet Cuts  | C69400 Off Analysis | See Tab C59400 |
|           | 12/16/1998    | 2,004   | O A 694 Billet Cuts  | C69400 Off Analysis | See Tab C69400 |
|           | 12/29/1998    | 4,120   | O.A. Billet Cuts   | C69400 Off Analysis | See Tab C69400 |
|           | 12/31/1998    | 2,666   | O.A. Cuts  | C69400 Off Analysis | See Tab C69400 |
|           | Total Pounds: | 112,156 |  |                     |                |
| 0269      |               |         |  |                     |                |
|           | 11/18/1998    | 31,422  | Mixed Forms of 6970 Mill Scrap   | C69700              | See Tab C69700 |
|           | 11/18/1998    | 31,338  | Mixed Forms of 6970 Mill Scrap   | C69700              | See Tab C69700 |
|           | 11/19/1998    | 32,796  | Mixed Forms of 6970 Mill Scrap   | C69700              | See Tab C69700 |
|           | 44/10/1008    | 4       | Control of the second s |                     |                |

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|--------------|---------------|-----------|---|---------------------|----------------|
|              | Total Pounds: | 126,150   |   |                     |                |
| 8269         |               |           |   |                     |                |
|              | 1/26/1998     | 12,314    | O.A. Cuts   | C69700 Off Analysis | See Tab C69700 |
|              | 2/11/1998     | 3,442     | O.A. 697 Cuts   | C69700 Off Analysis | See Tab C69700 |
|              | Total Pounds: | 15,756    |   |                     |                |
| 2060         |               |           |   |                     |                |
|              | 11/21/1998    | 2,710     | 1 Spill W/High Zn   | C70600 with Zinc    | See Tab C70600 |
|              | 11/30/1998    | 12,136    | 5 Fumace Spills   | C70600              | See Tab C70600 |
|              | Total Pounds: | 14,846    |   |                     |                |
| 7150         |               |           |   |                     |                |
|              | 11/30/1998    | 2,820     | 1 Fumace Spill  | C71500              | See Tab C71500 |
|              | 12/28/1998    | 6,094     | O.A. Billet Cuts  | C71500 Off Analysis | See Tab C71500 |
|              | Total Pounds: | 8,914     |   |                     |                |
| 2600         |               |           |   |                     |                |
|              | 3/23/1998     | 6,682     | 7608 O.A. Cuts  | C76000 Off Analysis | See Tab C76000 |
|              | Total Pounds: | 6,682     |   |                     |                |
| 870I         |               |           |   |                     |                |
|              | 7/22/1998     | 34,274    | Source Document is Casting Receipts & Shipments by Content printout for 7/22/1998; no invoice available | C11000              | See Tab C11000 |
|              | 11/5/1998     | 45,623    | Source Document is Casting Receipts & Shipments by Content printout for 11/5/1998, no invoice available | C11000              | Ses Tab C11000 |
|              | Total Pounds: | 79,897    |   |                     |                |
| 8702         |               |           |   |                     |                |

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| Chemical Content        | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc." | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc." | Approximately 70% metallic (copper and zinc) with balance being carbon, charcoal, graphite. etc.* | Approximately 70% metallic (copper and zinc) with balance being carbon, charcoal, graphite etc.* | Approximately 70% metallic (copper and zinc) with balance being carbon, charcoal, graphite, etc." | Approximately 70% metallic (copper, zinc and lead) with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metaliki (copper, zinc and lead) with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with batance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic (copper and zinc) with batance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic (copper and zinc) with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic (copper, zinc and lead) with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic (copper and zinc) with balance being carbon, charcoal, graphite, etc." | Approximately 70% metallic (copper, zinc and lead) with balance being carbon, charcoal, graphite, etc.* |
|-------------------------|---|---|---|--|---|---|---|---|---|---|---|---|---|---|
| CDA Number              |   |   |   |  |   |   |   |   |   |   |   |   |   |   |
| Description             | 6000 Series   | 6000 Saries   | 2000 Series   | 2000 Series  | 2000 Series   | 3000 Series   | 3000 Series   | 6000 Series   | 6000 Series   | 2000 Series   | 2000 Series   | 3000 Series   | 2000 Series   | 3000 Series   |
| Pounds                  | 33,936  | 31,588  | 34,432  | 33,264   | 35,220  | 33,876  | 34,844  | 34,464  | 22,908  | 11,576  | 34,668  | 33,550  | 34,432  | 34,912  |
| Metal Code Shipped Date | 8/30/1996   | 8/30/1996   | 9/8/1/896   | 9/1 1/1 995  | 9/18/1996   | 9/18/1996   | 9/19/1996   | 9/25/1996   | 9/26/1996   | 9/26/1996   | 9/27/1996   | 10/7/1996   | 10/10/1996  | 10/15/1996  |

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\* Breakdown provided by Mike Houston, GBC Metals, LLC.

etc.

| Chemical Content        | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphile, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic (copper, zinc and lead) with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphita, etc.* | Approximately 70% metallic (copper and zinc) with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic (copper, zinc and lead) with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic (copper, zinc and lead) with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metalic (copper and zinc) with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic (copper and zinc) with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic (copper and zinc) with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic (copper, zinc and lead) with balance being carbon, charcoal, graphile, etc.* | Approximately 70% metallic (copper and zinc) |
|-------------------------|---|---|---|---|---|---|---|---|--|---|---|---|---|--|
| CDA Number              |   |   |   |   |   |   |   |   |  |   |   |   |   |  |
| Description             | Fumace Screenings   | Fumace Screenings   | Fumace Screenings   | 3000 Series Furnace Screenings  | 6000 Series Furnace Screenings  | 2000 Series Furnace Screenings  | 3000 Series Furnace Screenings  | 3000 Series Furnace Screenings  | 2000 Series Furnace Screenings   | 6000 Series Furnace Screenings  | 2000 Series Furnace Screenings  | 2000 Series Furnace Screenings  | 3000 Series Furnace Screenings  | 2000 Series Furnace Screenings               |
| Pounds                  | 850'6   | 13,430  | 3,124   | 23,996  | 10,682  | 33,966  | 34,502  | 34,740  | 34,246   | 18,654  | 34,316  | 32,968  | 35,400  | 31,768                                       |
| Metal Code Shipped Dare | 12/22/1997  | 12/22/1997  | 12/23/1997  | 1/8/1998  | 1/8/1898  | 1/19/1998   | 1/20/1998   | 2/4/1998  | 2/5/1998   | 2/19/1998   | 9/1/1998  | 9/4/1998  | 9/9/1998  | 9/11/1998                                    |

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| Metal Code | Shipped Date | Pounds | Description        | CDA Number | Chemical Content   |
|------------|--------------|--------|--------------------|------------|--|
|            | 6/29/1999    | 33,430 | Fumace Skimmings   |            | Approximately 70% metallic with balance baing carbon, charcoal, graphile, etc.     |
|            | 7/12/1999    | 33,158 | Furnace Skimmings  |            | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.*    |
|            | 8/16/1999    | 33,666 | Furnace Skimmings  |            | Approximately 70% metallic with balance<br>being carbon, charcoal, graphite, etc.* |
|            | 8/27/1999    | 25,460 | Furnace Screenings |            | Approximately 70% metallic with balance<br>being carbon, charcoal, graphite, etc.* |
|            | 9/3/1999     | 32,704 | Fumace Skimmings   |            | Approximately 70% metallic with balance<br>being carbon, charcoal, graphite, etc.* |
|            | 9/10/1999    | 30,794 | Fumace Skimmings   |            | Approximately 70% metallic with balance<br>being carbon, charcoal, graphite, etc.* |
|            | 9/10/1999    | 29,186 | Fumace Skimmings   |            | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.*    |
|            | 9/14/1999    | 22,180 | Furnace Skimmings  |            | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.*    |
|            | 10/29/1999   | 14,614 | Fumace Skimmings   |            | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.*    |
|            | 11/18/1999   | 16,074 | Fumace Skimmings   |            | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.*    |
|            | 11/22/1999   | 26,836 | Furnace Skimmings  |            | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc."    |
|            | 11/29/1999   | 28,570 | Furnace Skimmings  |            | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.*    |
|            | 12/8/1999    | 34,430 | Furnace Skimmings  |            | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.*    |
|            | 2/15/2000    | 27,088 | Fumace Skimmings   |            | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.*    |
|            | 2/22/2000    | 31,196 | Furnace Skimmings  |            | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.*    |
|            | 3/1/2000     | 32,006 | Furnace Skimmings  |            | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.*    |
|            | 3/3/2000     | 32,686 | Furnace Skimmings  |            | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.*    |
|            | 3/8/2000     | 32,370 | Furnace Skimmings  |            | Approximately 70% metallic with balance being carbon, charcosl, graphite, etc.*    |

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| Chemical Content        | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance<br>being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance<br>being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc. | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* |
|-------------------------|---|---|---|---|---|---|---|---|---|--|--|---|---|---|---|---|--|---|
| CDA Number              |   |   |   |   |   |   |   |   |   |  |  |   |   |   |   |   |  |   |
| Description             | Furnace Skimmings   | Furnace Skimmings   | Furnace Skimmings   | Fumace Skimmings  | Fumace Skimmings  | 12 Boxes of Furnace SkimmIngs   | 11 Boxes of Furnace Skimmings   | Fumace Skimmings  | Furnaca Skimmings   | Fumace Skimmings   | Furnace Skimmings  | Fumace Skimmings  | Furnace Skimmings   | Fumaca Skimmings  | Furnace Skimmings   | Furnace Skimmings   | Furnace Skimmings  | Fumace Skimmings  |
| Pounds                  | 33,172  | 33,106  | 33,094  | 34,086  | 34,922  | 35,324  | 34,774  | 33,838  | 5,698   | 17,004   | 32,270   | 18,822  | 33,568  | 34,412  | 30,796  | 11,096  | 25,492   | 34,192  |
| Metal Code Shipped Date | 3/13/2000   | 3/21/2000   | 3/24/2000   | 3/27/2000   | 3/28/2000   | 4/5/2000  | 4/11/2000   | 4/18/2000   | 4/19/2000   | 4/25/2000  | 4/26/2000  | 4/28/2000   | 5/4/2000  | 5/10/2000   | 8/23/2000   | 5/24/2000   | 5/30/2000  | 5/31/2000   |
| Metal Co                |   |   |   |   |   |   |   |   |   |  | •  |   |   |   |   |   |  |   |

\* Breakdown provided by Mike Houston, GBC Metals, LLC. Monday, July 14, 2008

| Chemical Content        | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metalic with balance being carbon, charcoal, graphite, etc." | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc." | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc." | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc." | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc." | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc." | Approximately 70% metallic with balance being carbon, charcoal, 'graphite, etc." | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc." | Approximately 70% metallic with balance being carbon, charcoal, graphits, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc." |
|-------------------------|---|---|--|---|---|---|---|---|---|---|---|---|---|---|--|---|---|---|
| CDA Number              |   |   |  |   |   |   |   |   | ,   |   |   |   |   |   |  |   |   | •   |
| Description             | Fumace Skimmings  | Fumace Skimmings  | Furnace Skimmings  | Furnace Skimmings   | Fumace Skimmings  | Fumace Skimmings  | Fumace Skimmings  | Fumace Skimmings  | Fumace Skimmings  | Fumace Skimmings  | Furnace Skimmings   | Furnace Skimmings   | Furnace Skimmings   | Furnace Skimmings   | Furnace Skimmings  | Furnace Skimmings   | Furnace Skimmings   | Furnace Skimmings   |
| Pounds                  | 33,242  | 34,616  | 33,896   | 34,852  | 25,226  | 29,090  | 27,932  | 34,034  | 30,816  | 35,080  | 35,936  | 13,780  | 32,534  | 23,410  | 30,690   | 34,936  | 28,098  | 36,426  |
| Metal Code Shipped Date | 5/31/2000   | 6/13/2000   | 6/14/2000  | 6/20/2000   | 6/20/2000   | 6/20/2000   | 6/21/2000   | 6/21/2000   | 6/27/2000   | 7/11/2000   | 7/11/2000   | 7/12/2000   | 7/19/2000   | 7/21/2000   | 7/25/2000  | 7/27/2000   | 8/11/2000   | 8/15/2000   |
| Metal Code              |   |   |  |   |   |   |   |   |   |   |   |   |   |   |  |   |   |   |

\* Breakdown provided by Mike Houston, GBC Metals, LLC. Monday, July 14, 2008

| Chemical Content        | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc." | Approximately 70% metallic with balance being carbon, charcoal, graphile, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc." | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc." | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with batance being cerbon, charcoal, graphite, etc." | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc." | Approximately 70% metallic with balance being carbon, charcoal, graphile, etc." | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphita, etc." | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon charcoal graphite etc.* |
|-------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--|
| CDA Number              |   |   |   |   |   |   |   |   |   |   |   |   |   | •   |   |   |   |  |
| Description             | Furnace Skimmings   | Furnace Skimmings   | Furnace Skimmings   | Furnace Skimmings   | Furnace Skirnmings  | Furnace Skimmings   | Fumace Skimmings  | Furnace Skimmings   | Furnace Skimmings   | Fumace Skimmings  | Fumace Skimmings  | Fumace Skimmings  | Fumace Skimmings  | Furnace Skimmings   | Furnace Skimmings   | Furnace Skimmings   | Furnace Skimmings   | Furnace Skimmings  |
| Pounds                  | 31,860  | 34,440  | 33,468  | 31,520  | 33,230  | 32,094  | 34,838  | 12,390  | 34,382  | 36,002  | 33,724  | 29,362  | 33,846  | 33,018  | 34,818  | 17,770  | 17,324  | 28,674   |
| Metal Code Shipped Date | 8/17/2000   | 8/21/2000   | 8/23/2000   | 8/28/2000   | 9/19/2000   | 9/20/2000   | 9/21/2000   | 9/26/2000   | 9/27/2000   | 10/3/2000   | 10/4/2000   | 10/5/2000   | 10/10/2000  | 10/10/2000  | 10/18/2000  | 10/20/2000  | 10/23/2000  | 10/26/2000   |
| Metal (                 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |

\* Breakdown provided by Mike Houston, GBC Metals, LLC.

\* Breakdown provided by Mike Houston, GBC Metals, LLC.

| Chemical Content        | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc." | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc." | Approximately 70% metallic with balance being cerbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphlte, etc." | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc." | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc." | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc." | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc." | Approximately 70% metallic with balance being carbon, charcoal, graphite, etc.* |
|-------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CDA Number              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Description             | Skimmings   | Fumace Skimmings  | Furnace Skimmings   | Furnace Skimmings   | Furnace Skimmings   | Furnace Skimmings   | Fumace Skimmings  | Furnace Skimmings   | Fumace Skimmings  |
| Pounds                  | 5,108   | 33,384  | 27,872  | 34,714  | 34,670  | 14,966  | 34,540  | 34,426  | 32,364  | 26,228  | 24,666  | 35,204  | 5,680   | 15,244  | 28,666  | 34,548  | 13,288  | 33,910  |
| Metal Code Shipped Date | 1/15/2001   | 1/22/2001   | 1/31/2001   | 2/1/2001  | 2/1/2001  | 2/1/2001  | 2/8/2001  | 2/14/2001   | 3/9/2001  | 3/12/2001   | 3/14/2001   | 3/22/2001   | 4/18/2001   | 4/20/2001   | 4/26/2001   | 5/2/2001  | 5/8/2001  | 5/10/2001   |

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| Menn Cone Sumbea Date |               |           |                                 |   |  |
|-----------------------|---------------|-----------|---------------------------------|---|--|
|                       | 7/6/2001      | 34,972    | Furnace Skimmings               |   | Approximately 70% metallic with balance<br>being carbon, charcoal, graphite, etc." |
|                       | 7/6/2001      | 33,606    | Furnace Skimmings               |   | Approximately 70% metallic with balance being carbon, charcoal, graphile, etc.*    |
|                       | Total Pounds: | 8,865,535 |                                 |   |  |
| 8724                  |               |           | ·                               |   |  |
| -                     | 4/19/2001     | 37,846    | Copper Oxide 75% Metal /100% CU | * | Copper Oxide (approximately 75% metal 100% of which is Cu)                         |
|                       | Total Pounds: | 37,946    |                                 |   |  |
| 8725                  |               |           |                                 |   |  |
|                       | 5/27/1998     | 31,282    | Casting Salvage                 |   | Mixed metal consisting of many different alloys*                                   |
|                       | 5/27/1998     | 34,468    | Casting Salvage                 |   | Mixed metal consisting of many different alloys*                                   |
|                       | 5/28/1998     | 29.040    | Casting Salvage                 |   | Mixed metat consisting of many different alloys*                                   |
|                       | 5/28/1998     | 31,858    | Casting Salvage                 |   | Mixed metal consisting of many different alloys*                                   |
|                       | 6/1/1998      | 24,142    | Casting Salvage                 |   | Mixed metal consisting of many different alloys*                                   |
|                       | 8/18/1998     | 30,092    | Casting Salvage                 |   | Mixed metal consisting of many different alloys*                                   |
|                       | 11/23/1996    | 33,420    | Casting Salvage                 |   | Mixed metal consisting of many different alloys*                                   |
|                       | 11/24/1996    | 21,648    | Casting Salvage                 |   | Mixed metal consisting of many different alloys*                                   |
|                       | 11/25/1998    | 26,172    | Casting Salvage                 |   | Mixed metal consisting of many different alloys*                                   |
|                       | 11/30/1998    | 2,818     | 3 Furnace Spills                |   | Mixed metal consisting of many different alloys."                                  |
|                       | 1/30/1999     | 14,212    | Casting Salvage                 |   | Mixed metal consisting of many different alloys."                                  |
|                       | 2/2/1999      | 33,446    | Casting Salvage                 |   | Mixed metal consisting of many different   |

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| Chemical Content        | Mixed metal consisting of many different alloys* | Mixed metal consisting of many different alloys* | Mixed metal consisting of many different alloys: | Mixed metal consisting of many different attoys* | Mixed metal consisting of many different alloys* | · Mixed metal consisting of many different alloys* | Mixed metal consisting of many different alloys* | Mixed metal consisting of many different alloys. | Mixed metal consisting of many different alloys* | Mixed metal consisting of many different altoys* | Mixed metal consisting of many different alloys* |
|-------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| CDA Number              |  |  |  |  | ·  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Description             | Casting Salvage                                  | Casting Salvage                                  | Casting Salvage                                  | Casting Salvage                                  | Low Grade Casting Salvage                        | High Grade Casting Salvage                       | Low Grade Casting Salvage                        | Low Grade Casting Salvage                        | Low Grade Casting Salvage                        | High Grade Casting Salvage                         | Low Grade Casting Salvage                        | High Grade Casting Salvage                       | High Grade Casting Salvage                       | High Grade Casting Salvage                       | Casting Salvage                                  | Casting Salvage                                  | Casting Salvage                                  | Casting Salvage                                  |
| Pounds                  | 10,318   | 23,498   | 19,456   | 11,968   | 35,028   | 5,624  | 22,132   | 35,212   | 26,900   | 13,532   | 20,486   | 28,822   | 7,832  | 12,278   | 1,958  | 572  | 1,038  | 3,660  |
| Metal Code Shipped Date | 2/3/1999   | 2/3/1999   | 2/3/1999   | 2/3/1999   | 2/4/1999   | 2/4/1999   | 2/4/1999   | 2/4/1999   | 2/5/1999   | 2/5/1998   | 2/5/1999   | 2/5/1999   | 2/5/1999   | 2/10/1999  | 6/20/1989  | 986 1/02/9                                       | 5/20/1999  | 5/20/1999  |
| Metal Code              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| Metal Code Shipped Date | Pounds | Description                          | CDA Number | Chemical Content   |
|-------------------------|--------|--------------------------------------|------------|--|
| 10/4/1899               | 5,016  | Casting Salvage After Sorting        |            | Mixed metal consisting of many different alloys*           |
| 10/5/1999               | 6,620  | Casting Salvage After Sorting        |            | Mixed metal consisting of many different alloys*           |
| 11/15/1999              | 11,590 | Mixed Baler Scrap Grease             |            | Mixed metal consisting of many different altoys.           |
| 11/17/1999              | 2,330  | Mixed Baler Scrap Grease             | ٠          | Mixed metal consisting of many different alloys*           |
| 4/17/2000               | 19,902 | Casting Salvage                      |            | Mixed metal consisting of many different alloys*           |
| 5/30/2000               | 1,048  | Mixed Casting Salvage                |            | Mixed metal consisting of many different alloys*           |
| 6/21/2000               | 1,412  | Mixed Furnace Spill                  |            | Mixed metal consisting of many different alloys*           |
| 6/21/2000               | 4,498  | Mixed Sheet Scrap W/ Staples         |            | Mixed metal consisting of many different altoys*           |
| 0/28/2000               | 9,578  | Casting Salvage                      |            | Mixed metal consisting of many different alloys*           |
| 10/5/2000               | 6,298  | Casting Salvage (60% Metal / 70% CU) | ·          | Mixed metal (approximately 60% metal, 70% of which is Cu)* |
| 10/23/2000              | 1,322  | Mixed Tinned Brasses                 |            | Mixed metal consisting of many different alloys*           |
| 10/23/2000              | 1,236  | Lab Scrap                            |            | Mixed metal consisting of many different alloys*           |
| 10/25/2000              | 31,158 | Furnace Skimmings                    |            | Mixed metal consisting of many different alloys*           |
| 10/25/2000              | 1,334  | Mixed Tinned Brasses                 |            | Mixed metal consisting of many different alloys*           |
| 12/22/2000              | 3,026  | Mixed Chips - "Borings"              |            | Mixed metal consisting of many different alloys*           |
| 12/27/2000              | 32,904 | Casting Salvage                      |            | Mixed metal consisting of many different alloys*           |
| 12/27/2000              | 13,946 | Casting Salvage                      |            | Mixed metat consisting of many different alloys*           |
| 12/28/2000              | 4,078  | Casting Salvage                      |            | Mixed metal consisting of many different alloys*           |

\* Breakdown provided by Mike Houston, GBC Metaks, LLC.

| Chemical Content        | Mixed metal consisting of many different alloys* | Mixed metal consisting of many different alloys." | Mixed metal consisting of many different alloys* | Mixed metal consisting of many different alloys* | Mixed metal consisting of many different alloys* | Mixed metal consisting of many different altoys* | Mixed metal consisting of many different alloys* | Mixed metal consisting of many different alloys* |
|-------------------------|--|--|--|--|--|--|--|--|--|--|--|---|--|--|--|--|--|--|
| CDA Number              |  |  |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |
| Description             | Casting Salvage                                  | Casting Salvage                                  | Casting Salvage - Sorted                         | Casting Salvage - Sorted                         | Casting Salvage - Unsorted                       | Casting Salvage - Sorted                         | Casting Salvage - Unsorted                       | Casting Salvage - Sorted                         | Casting Salvage - Unsorted                       | Casting Salvage - Unsorted                       | Casting Salvage - Sorfed                         | Casting Salvage - Unsorted                        | Casting Salvage - Sorted                         | Casting Salvage - Unsorted                       | Casting Salvage - Sorted                         | Casting Salvage - Unsorled                       | Casting Salvage - Sorted                         | Casting Salvage - Unsorted                       |
| Pounds                  | 15,472   | 16,288   | 33,966   | 22,280   | 10,962   | 18,542   | 5,932  | 5,502  | 15,930   | 3,098  | 3,496  | 22,707  | 3,010  | 21,110   | 13,214   | 16,696   | 16,112   | 5,562  |
| Metal Code Shipped Date | 12/28/2000                                       | 12/28/2000                                       | 1/3/2001   | 1/4/2001   | 1/4/2001   | 1/5/2001   | 1/5/2001   | 1/8/2001   | 1/8/2001   | 1/15/2001  | 1/16/2001  | 1/16/2001   | 1/16/2001  | 1/17/2001  | 1/17/2001  | 1/18/2001  | 1/18/2001  | 1/23/2001  |

\* Breakdown provided by Mike Housson, GBC Metals, LLC.

| Metal Code Shipped Date |               | rounas    | Describnon                          |   |  |
|-------------------------|---------------|-----------|-------------------------------------|---|--|
|                         | 1/23/2001     | 20,090    | Casting Salvage - Soried            |   | Mixed metal consisting of many different alloys*           |
|                         | 3/12/2001     | 4,082     | Rotocone Sludge                     |   | Mixed metal consisting of many different alloys*           |
|                         | 4/18/2001     | 3,722     | Casting Salvage 60% Metal / 70% CU  |   | Mixed metal (approximately 60% metal, 70% of which is Cu)* |
|                         | 4/19/2001     | 35,274    | Casting Salvage 60% Metal / 70% CU  |   | Mixed metal (approximately 60% metal, 70% of which is Cu)* |
|                         | 4/20/2001     | 33,318    | Casting Salvage 60% Metal / 70% CU  |   | Mixed metal (approximately 60% metal, 70% of which is Cu)* |
|                         | 4/20/2001     | 19,828    | Casting Salvage 60% Metal / 70% CU  |   | Mixed metal (approximately 60% metal, 70% of which is Cu)* |
|                         | 5/16/2001     | 32,366    | Casting Salvage - 40% Metal, 70% CU |   | Mixed metal (approximately 40% metal, 70% of which is Cu)* |
|                         | 5/17/2001     | 24,564    | Casting Salvage - 40% Metal, 70% CU |   | Mixed metal (approximately 40% metal, 70% of which is Cu)* |
|                         | 5/17/2001     | 11,154    | Casting Salvage - Transformers      |   | . Mixed metal consisting of many different alloys*         |
|                         | 5/24/2001     | 6,416     | Casting Salvage                     |   | Mixed metal consisting of many different alloys*           |
|                         | Total Pounds: | 1,188,899 |                                     |   |  |
| 8726                    |               |           |                                     |   |  |
|                         | 1/16/1996     | 32,862    | Ajax Pit Cleaning                   |   | Mixed metai⁴   |
|                         | 2/19/1996     | 31,518    | Pit Cleanings                       |   | Mixed metal*   |
|                         | 2/20/1996     | 32,356    | Pit Cleanings                       |   | Mixed metal*   |
|                         | 2/21/1996     | 33,360    | Pit Cleanings                       |   | Mixed metal*   |
|                         | 2/22/1996     | 31,918    | Scrap                               |   | Mixed metal*   |
|                         | 2/23/1996     | 33,018    | Scrap                               |   | Mixed metal*   |
|                         | 2/27/1996     | 27,608    | Scrap                               |   | Mixed metal*   |
|                         | 3/29/1996     | 33,002    | Pit Cleanings                       | • | Mixed metal*   |
|                         | 4/2/1996      | 34,932    | Pit Cleanings                       |   | Mixed metal*   |
|                         | 4/9/1996      | 34 836    | Pit Cleanings                       |   | Mixed metal*   |

\* Breakdown provided by Mike Housson, GBC Metals, LLC.

| Metat Code | 9/28/1999     | 11 070  | Alay Di Cleaning   | Mixed metal*  |
|------------|---------------|---------|--|---|
|            | 9/20/1999     | 25. 4   | A RAY THE CHEST THE SAME AND THE CHEST THE CHE | Mixed metal*  |
|            | 10/5/1999     | ы<br>20 | Ajax Pit Cleanings   | Mixed metal   |
|            | 11/17/1999    | 10,536  | Ajax Pit Cteanings   | Mixed metal⁵  |
|            | 11/18/1999    | 9,346   | Ajax Pit Cleanings   | Mixed metal⁵  |
|            | 4/19/2000     | 29,038  | Tank Cleanings   | Mixed metal*  |
|            | 6/15/2000     | 34,068  | Tank Cleanings   | Mixed metal*  |
|            | 6/16/2000     | 36,172  | Tenk Cleanings   | Nixed metal*  |
|            | 7/12/2000     | 14,076  | Ajax Tank Cleanings  | Mixed metal*  |
|            | 10/19/2000    | 8,290   | Ajax Tank Cleanings (80% Metal/80% CU)   | Approximately 80% metal, 80% of which is Cu                 |
|            | 7/19/2001     | 16,686  | Tank Cleanings 60% Metal 70% CU  | Approximately 60% metal, 70% of which is Cu                 |
|            | 7/19/2001     | 16,686  | Tark Cleanings 60% Metal 70% CU  | Approximately 60% metal, 70% of which is Cu                 |
|            | Total Pounds: | 530,686 |  |   |
|            |               |         |  |   |
|            | 11/21/1998    | 7.240   | Mixed Sheet Mill Scrap   | Mixed sheet mill scrap consisting of many different alloys* |
|            | 12/17/1998    | 2,262   | Mixed Sheet Mill Scrap   | Mixed sheet mill scrap consisting of many different alloys* |
|            | 12/23/1998    | 4,348   | Mixed Sheet Mill Scrap   | Mixed sheet milt scrap consisting of many different alloys* |
|            | 6/8/1899      | 2,298   | Mixed Sheet Scrap  | Mixed sheet mill acrap consisting of many different alloys* |
|            | 9/28/1999     | 6,580   | Mixed Sheet Mill Scrap W/ Steel Sta  | Mixed sheet mill scrap consisting of many different alloys* |
|            | 10/4/1999     | 1,746   | Mixed Sheet Mill Scrap w/ Grease   | Mixed sheet mill scrap consisting of many different alloys* |
|            | 10/5/1999     | 3,996   | Mixed Sheet Mill Scrap w/ Grease   | Mixed sheet mill screp consisting of many different alloys* |
|            | 11/15/1899    | 3,086   | Mixed Sheet Mill Scrap With Steel  | Mixed sheet mill scrap consisting of many                   |

<sup>\*</sup> Breakdown provided by Mike Houston, GBC Metals, LLC.

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\* Breakdown provided by Mike Houston, GBC Metals, LLC.

\* Breakdown provided by Mike Houston, GBC Metals, LLC.

| Metal Code | Metal Code Shipped Date | Pounds    | Description                     | CDA Number | Chemical Content |
|------------|-------------------------|-----------|---------------------------------|------------|------------------|
|            | 6661/8/9                | 9,580     | Floor Sweeps                    |            | Unavailable      |
|            | 9/28/1999               | 13,370    | Floor Sweepings                 |            | Unavailable      |
|            | 10/4/1999               | 7,572     | Floor Sweepings                 |            | Unavailable      |
|            | 10/19/1999              | 16,646    | Floor Sweepings                 |            | Unavailable      |
|            | 10/20/1999              | 2,028     | Floor Sweepings                 |            | Unavailable      |
|            | 10/29/1999              | 8,652     | Floor Swaepings                 |            | Unavailable      |
|            | 4/6/2000                | 15,036    | 4 Boxes of Floor Sweeps         |            | Unavailable      |
|            | 4/17/2000               | 7,072     | Floor Sweeps                    |            | Unavailable      |
|            | 4/25/2000               | 15,192    | Floor Sweepings (March Sale)    |            | Unavailable      |
|            | 5/24/2000               | 362       | Steel Transformer W/ CU Bus Bar |            | Unavailable      |
|            | 7/21/2000               | 8,304     | Floor Sweeps                    |            | Unavailable      |
|            | 7/25/2000               | 2,568     | Floor Sweeps                    |            | Unavailable      |
|            | 12/22/2000              | 5,714     | Floor Sweeps                    |            | Unavailable      |
|            | 12/27/2000              | 8,034     | Floor Sweeps                    |            | Unavailable ·    |
|            | 1/2/2001                | 2,520     | Floor Sweeps                    |            | Unavailable      |
|            | 1/15/2001               | 3,158     | Floor Sweeps                    |            | Unavailable      |
|            | 4/26/2001               | 1.362     | Floor Sweepings                 | ·          | Unavailable      |
|            | 5/8/2001                | 6,686     | Floor Sweeps                    |            | Unavailable      |
|            | 5/21/2001               | 7,734     | Floor Sweeps                    |            | Unavailable      |
|            | 5/22/2001               | 1,442     | Floor Sweeps                    |            | Unavailable      |
|            | 5/24/2001               | 1,206     | Floor Sweeps                    |            | Unavaitable      |
|            | 8/22/2001               | 5,654     | Floor Sweeps                    |            | Unavailable      |
|            | 9/14/2001               | 4,422     | Floor Sweeps                    | ٠          | Unavailable      |
|            | Total Pounds:           | : 193,048 |                                 |            |                  |

\* Breakdown provided by Mike Houston, GBC Metals, LLC.

# **Tab C11000**

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# Copperati

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## **Search Results**

C11000 (Electrolytic Tough Pitch)

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           | Cu <sup>(1)</sup> | 0  |
|-----------|-------------------|----|
| Min./Max. | 99.90 min         | E  |
| Nominal   | -                 | 04 |

(1) Cu value includes Ag.

Note: This is a high conductivity copper which has, in the annealed condition a minimum concuctivity of 100%

IACS except for Alloy C10100 which has a minimum conductivity of 101% IACS.

Note: Oxygen and trace elements may vary depending on the process.

Applicable Specifications

| Product                    | Specification  |
|----------------------------|--|
| Bands, Projectile Rotating | MILITARY MIL-B-20292                                 |
| Bar                        | ASME SB133<br>ASTM B152<br>SAE J463, J461            |
| Bar, Bus                   | ASTM B187  |
| Bar, Forging               | ASTM B124  |
| Bolts                      | ASTM F468  |
| Brazing Filler Metal       | FEDERAL QQ-B-650                                     |
| Foil, Printed Circuits     | ASTM B451  |
| Forgings, Die              | ASTM B283  |
| Nuts                       | ASTM F467  |
| Pipe, Bus                  | ASTM B188  |
| Plate                      | AMS 4500<br>ASTM B152<br>SAE J461, J463              |
| Rod                        | ASME SB133<br>MILITARY MIL-C-12166<br>SAE J461, J463 |
| Rod, Bus                   | ASTM B187  |
| Rod, Forging               | ASTM B124  |
| Screws                     | ASTM F468  |

http://www.copper.org/resources/properties/db/CDAPropertiesResultServlet.jsp?action=search

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| Shapes                       | SAE J461, J463  |
|------------------------------|---|
| Shapes, Bus                  | ASTM B187   |
| Shapes, Forging              | ASTM B124   |
| Sheet                        | AMS 4500<br>ASTM B152, B694<br>SAE J463, J461                               |
| Sheet, Building Construction | ASTM B370   |
| Sheet, Clad                  | ASTM B506   |
| Sheet, Lead Coated           | ASTM B101   |
| Sheet, Printed Circuits      | ASTM B451   |
| Strip                        | AMS 4500<br>ASTM B694, B152<br>SAE J463, J461                               |
| Strip, Building Construction | ASTM B370   |
| Strip, Clad                  | ASTM B506   |
| Strip, Printed Circuits      | ASTM B451   |
| Studs                        | ASTM F468   |
| Tube, Bus                    | ASTM B188   |
| Tube, Welded                 | ASTM B447   |
| Wire, Medium-Hard Drawn      | ASTM B2<br>FEDERAL QQ-W-343   |
| Wire, Coated With Lead Alloy | ASTM B189   |
| Wire, Coated With Nickel     | ASTM B355   |
| Wire, Coated With Silver     | ASTM B298   |
| Wire, Coated With Tin        | ASTM B246, B33  |
| Wire, Flat                   | AMS 4500<br>ASTM B272   |
| Wire, Hard Drawn             | ASTM B1<br>FEDERAL QQ-W-343   |
| Wire, Metallizing            | MILITARY MIL-W-6712   |
| Wire, Soft                   | ASTM B3, B738, B48<br>FEDERAL QQ-W-343<br>SAE.J461, J463                    |
| Wire, Stranded               | ASTM B8, B496, B470, B286, B229, B226, B174, B173, B172<br>FEDERAL QQ-B-575 |
| Wire, Trolley                | ASTM B47, B116  |

### **Common Fabrication Processes**

Blanking, Coining, Coppersmithing, Drawing, Etching, Forming and Bending, Heading and Upsetting, Hot Forging and Pressing, Piercing and Punching, Roll Threading and Knurling, Shearing, Spinning. Squeezing and Swaging, Stamping

**Fabrication Properties** 

| Tablication (Topolico    |                 |
|--------------------------|-----------------|
| Joining Technique        | Suitability     |
| Soldering                | Excellent       |
| Brazing                  | Good            |
| Oxyacetylene Welding     | Not Recommended |
| Gas Shielded Arc Welding | Fair            |
| Coated Metal Arc Welding | Not Recommended |
|                          |                 |

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| Spot Weld                      | Not Recommended |
|--------------------------------|-----------------|
| Seam Weld                      | Not Recommended |
| Butt Weld                      | Good            |
| Capacity for Being Cold Worked | Excellent       |
| Capacity for Being Hot Formed  | Excellent       |
| Forgeability Rating            | 65              |
| Machinability Rating           | 20              |

| Temper   Size   Work   Min   |                  | _                     |                            |
|--|------------------|-----------------------|----------------------------|
| Fiat Products    102   | Shear<br>Strengt | Fatigue<br>h Strongth | izod<br>Impact<br>Strength |
| Flat Products    102   | 0 ksi            | kei                   | R-lb                       |
| HOZ  | MPa              | MPa                   | ų                          |
| 1  |                  |                       |                            |
| M20  | 26               | 13                    | 0.0                        |
| Rod  | 179              | 90                    | 0.0                        |
| Rod  M20   | 22               | <u>+</u>              | 0.0                        |
| M20  | 152              | <u> </u>              | 0,0                        |
| 25.4   | 22               | 1                     | 0.0                        |
| Shapes   | 152              | 1                     | 0.0                        |
| M30 0.5 0 TYP 68 32 10   | 132              | <u> </u>              | p.0                        |
| 12.7   | 22               | F                     | 0.0                        |
| M20  | 152              | -                     | 0.0                        |
| 12.7   | 22               | -                     | 0.0                        |
| Flat Products  #104  | 152              | 1                     | 0.0                        |
| H04 0.04 0 TYP 58 50 45 - 6 50 90 57   |                  | <u> </u>              | <del></del>                |
| Rod  #104 0.25 40 TYP 68 55 50 - 10 60 94  | 28               | -                     | 0.0                        |
| H04 0.25 40 TYP 88 55 50 - 10 60 94  | 193              |                       | 0.0                        |
| Signature   Sign |                  |                       |                            |
| Wire  OS050 0.08 0 TYP 88 36 355 355 355 355   | 29               | ⇟——                   | 0.0                        |
| OSBSO 0.98 0 TYP 88 35 355 355 355 355 355 355 355 355 355 355 355   | 200              | <u>t</u>              | 0.0                        |
| Plat Products  | la i             | E                     | h o                        |
| Flat Products  H08   | 24               | +                     | 0.0                        |
| H08  | 165              | <u> </u>              | 0.0                        |
| 1  | 29               | 14                    | 0.0                        |
| H01 0.025 0 TYP 88 38 30 - 35 25 70  | 200              | 97                    | 0.0                        |
| Column   | 25               | +                     | 0.0                        |
| Rod  OS050 1 0 TYP 58 32 10 - 55 - 40  | 172              |                       | 0.0                        |
| OS080 1 0 TYP 68 32 10 - 55 - 40   |                  | 1                     | <del></del>                |
| Wire  H08  | 22               | F                     | 0.0                        |
| H08  | 152              | 1                     | 0.0                        |
| 2 20 455 1 1 1   |                  |                       |                            |
| Flat Products  H04   | 33               |                       | 0.0                        |
| H04 1 0 TYP 88 45 40 - 20 45 85  | 228              | <u> </u>              | 0.0                        |
| 25.4 20 010 276 - 20 45 85   | -                |                       | T                          |
| OS060 0.025 0 TYP 68 32 10 - 50 - 40   | 26               | +                     | 0.0                        |
| 0 64 20 221 69 - 50 40 · · · · · · · · · · · · · · · · · ·   | 179              | 1                     | 0.0                        |
| H00 0.025 0 TYP 88 38 28 40 10 80 Rod  | 22<br>152        | +                     | 0.0                        |
| 0.64 20 248 193 40 10 - 80 Rod   |                  | t                     |                            |
| Rod  | 25               | f-                    | 0.0                        |
|  | 172              | <u>f</u>              | μ.υ                        |
|  | 27               | 17                    | 0.0                        |
|  | 188              | 117                   | 0,0                        |
|  | 26               | +                     | 0.0                        |
|  | 176              | t                     | 0.0                        |

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| 05025             | 0.065 | Ü            | TYP  | 30       | 34        | 11       |  | 45-   | ks.  | -        | FF   | 23  | Ŧ  | 0.0  |
|-------------------|-------|--------------|--|----------|-----------|----------|--|-------|--|----------|--|-----|--|------|
|                   | 1.65  | 1            | 1  | 20       | 234       | 76       |  | 45    | 15   | -        | 1  | 159 | 丁  | 0.0  |
| H80               | 0.065 | 40           | ТҮР  | 68       | 55        | 50       |  | 8 60  | 95 8   | 3 -      | <del> </del>                                     | 29  | +-   | 0.0  |
|                   | 1.85  | 1            |  | 20       | 379       | 345      | -  | 8 60  | 956  | i3 -     |  | 200 | 7  | 0,0  |
| 155               | 0.065 | 15           | TYP  | 88       | 40        | 32       |  | 2535  | 177  | 5 -      | † †  | 26  | ┿  | 0.0  |
|                   | 1,65  |              |  | 20       | 276       | 221      |  | 25 35 | . 774  | 5        | T  | 179 | <b>T</b>   | 0.0  |
| Flat Pro          | ducts | ٠            |  |          |           |          |  |       |  |          |  |     | <del>-!</del> -                                  |      |
| M20               | 0,04  | 0            | TYP  | 88       | 34        | 10       | E  | 45    | 145  | ŀ        | ŀŀ   | 23  | Ŧ  | 0.0  |
|                   | 1     |              |  | 20       | 234       | 69       | -  | 45-   | 45   | -        | F F  | 159 | 7  | 0.0  |
| Shapes            | `     |              |  |          |           |          |  |       |  |          |  |     |  |      |
| OS050             | 0.5   | þ            | ΤYΡ  | 86       | 32        | 10       | -  | 50-   | 40   |          | F F.   | 5.5 | -  | 0.0  |
|                   | 12.7  |              | L  | 20       | 221       | 69       | <u></u>                                      | 50-   | - 40-  | <u> </u> | <u> </u>   | 152 | <u> </u>   | 0.0  |
| Wire              |       |              |  |          |           | ,        |  |       |  |          |  |     |  |      |
| H04               | 0.08  | 0            | ĪΫΡ  | _        | 55        | _t       | <u>-                                    </u> | 1 -   | Į.   | -        | FE   | 29  | +  | 0.0  |
|                   | 2     |              |  | 20       | 379       | -        | <u></u>                                      | 1 -   | <u>·                                    </u> |          | <u> </u>   | 200 | +  | 0.0  |
| Flat Pro          |       |              |  |          |           |          |  |       |  |          |  |     |  |      |
| OS050             | 0.04  | 0            | TYP  | _        | 32        | 10       | <del></del> -                                | +++   | 40   | -        | <del>     </del>                                 | 22  | +  | 0.0  |
|                   | 1     |              |  | 20       | 221       | 69       | +  | 45    | 40-  |          | <u>. 난 노</u>                                     | 152 | <u> </u>   | 0.0  |
| Shapes            |       |              |  |          |           |          |  |       |  |          |  |     |  |      |
| H04               | 0.5   | 15           | ΤΥΡ  |          | 40        | 32       | <u> </u>                                     | 3035  | ╬╬   | _        | ┾┾   | 26  | <del></del>                                      | 0.0  |
|                   | 12.7  | <u> </u>     |  | 20       | 276       | 221      | <u> </u>                                     | 3035  | <u> </u>                                     | · -      | <u> </u>   | 179 | <u>.t</u>  | 0,0  |
| Tube              | n nor | T            | le in  | <u> </u> |           |          |  | 7     | Taal   |          |  |     | <del></del>                                      |      |
| OS050             |       | <u>р</u> _   | ТҮР  | 68<br>20 | 32<br>221 | 10<br>69 | -  | _     | 40   | -        | ++   | 22  | ╪  | 0.0  |
| -1 B              | 1.65  | <u> </u>     | _  | ۲۰       | 221       | O3       | <u> </u>                                     | 45    | <u> </u>                                     | <u> </u> | 1.1.   | 152 | <u> </u>   | 0,0  |
| Flat Pro<br>OS025 |       | ю            | ТҮР  | R.S      | 34        | 11       |  | 454   | . <b>M</b> 5-                                | 1        | 1. 1.  | 23  | 11   | ki.o |
| <del></del>       | 1     | Ť            | <del>                                     </del> | 20       | 234       | 76       |  |       | 15   |          | 11   | 159 | 76   | 0.0  |
| H10               | 0.04  | 6            | TYP  |          | 57        | 53       |  |       | 956  | <u> </u> | <del>-[-[-</del>                                 | 29  | +  | 0.0  |
| . 10              | 1     | Ť            | † <del>''</del>                                  | 20       | 393       | 365      | <del> [</del>                                | 4 82  | 956  |          | <del>[ [</del>                                   | 200 | 1  | 0.0  |
| H01               | 0.04  | <del> </del> | ТҮР  |          | 38        | 30       |  | 25/25 |  |          | 1  | 25  | <del>[                                    </del> | 0.0  |
| .~1               | 1     | Ť            | 1117   | 20       | 262       | 207      |  | 25 25 | 70   | _        | <del>1                                    </del> | 172 |  | 0.0  |
| H00 .             | 0.04  | 6            | ΤΫ́P   |          | 36        | 26       | <u> </u>                                     | 30 10 |  |          | <del>- [ - [</del>                               | 25  | ╌  | 0.0  |
| 100               | 4     | Ť            | -  | 20<br>00 | 248       | 193      |  | 3010  | -  |          | ŦŤ   | 172 | <del></del>                                      | 0.0  |
|                   | ľ     | 1            | L  | ۲.       |           | : =      |  |       |  | ۳ -      |  |     |  |      |
| H04               | 0 025 | Ю            | TYP  | 00       | 50        | 45       |  | 1250  |  |          |  | 28  |  | 0.0  |

<sup>\*</sup>Fatigue Strength: 100 x 10 <sup>6</sup>cycles, unless indicated as [N]X 10<sup>6</sup>.

**Physical Properties** 

|                                  | US Customary                                | Metric                                   |
|----------------------------------|---|--|
| Melting Point - Liquidus         | 1981 F                                      | 1083 C                                   |
| Melting Point - Solidus          | 1949 F                                      | 1065 C                                   |
| Density*                         | 0.322 lb/in <sup>3</sup> at 68 F            | 8,91 gm/cm <sup>3</sup> @ 20 C           |
| Specific Gravity                 | 8.91  | 8.91                                     |
| Electrical Resistivity           | 10.3 ohms-cmil/ft @ 68 F                    | 1.71 microhm-cm @ 20 C                   |
| Electrical Conductivity**        | 101 %IACS @ 68 F                            | 0.591 MegaSiemens/cm @ 20 C              |
| Thermal Conductivity             | 226.0 Btu · ft/(hr · ft2.ºF)at 68           | IF391.1 W/m ⋅ °K at 20 C                 |
| Coefficient of Thermal Expansion |   | 16.9 ·10 <sup>-6</sup> per °C (20-100 C) |
| Coefficient of Thermal Expansion | on 9.6 ·10 <sup>-8</sup> per °F (68-392 F)  | 17.3 ·10 <sup>-6</sup> per °C (20-200 C) |
| Coefficient of Thermal Expansion | on 9.8 · 10 <sup>-6</sup> per °F (68-572 F) | 17.6 ·10 <sup>-8</sup> per °C (20-300 C) |
| Specific Heat Capacity           | 0.092 Btu/lb/ºF at 68 F                     | 393.5 J/kg · ºK at 293 K                 |
| Modulas of Elasticity in Tension | 17000 ksi                                   | 117000 MPa                               |
| Modulus of Rigidity              | 6400 ksi                                    | 44130 MPa                                |

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\*Actual value .321 - .323.

\*\*Volume and weight basis.

Tempers Most Commonly Used

| rempers most commonly osed |   |  |  |  |  |
|----------------------------|---|--|--|--|--|
| Flat Products              |   |  |  |  |  |
| BAR, DRAWN                 | H01, H04, H06, O60                            |  |  |  |  |
| BAR, ROLLED                | H01, H04, H06, M20, O60                       |  |  |  |  |
| PLATE                      | H00, M20, O60                                 |  |  |  |  |
| SHEET                      | H00, H02, M20, O60                            |  |  |  |  |
| STRIP, DRAWN               | H04, O60                                      |  |  |  |  |
| STRIP, ROLLED              | H00, H01, H02, H04, H08, H10, M20, O60, OS025 |  |  |  |  |
| WIRE, DRAWN                | H04, H06, O60                                 |  |  |  |  |
| WRE, ROLLED                | H04, O60                                      |  |  |  |  |

| Other  |                           |
|--------|---------------------------|
| ROD    | H04, M20, O60             |
| SHAPES | H04, M20, M30, O60        |
| TUBE   | H55, H58, H80, O60, OS025 |
| WIRE   | H00, H01, H04, H08, O60   |

### **Typical Uses**

Architecture

Skylight Frames, Roofing, Building Fronts, Flashing, Gutters, Spouting, Downspouts

**Automotive** 

Gaskets, Radiators

**Builders Hardware** 

Butts, Tacks, Nails, Soldering Copper, Rivets, Cotter Pins, Ball Floats

Building

Screening, Wire Screening

Consumer

Christmas Ornaments

Electrical

Terminals, Switches, Radio Parts, Contacts, Trolley Wire, Magnet Wire, Busbars, Terminal Connectors, Conductors, Electrical, Stranded Conductors, Wire, Electrical

**Fasteners** 

**Fasteners** 

Industrial

Printing Rolls, Chimney Cap Screens, Heat Exchangers, Anodes, Kettles, Chlorine Cells, Rotating Bands, Road Bed Expansion Plates, Vats, Pressure Vessels, Chemical Process Equipment, Pans

Start Another Search

#### **DISCLAIMER:**

The values listed above represent reasonable approximations suitable for general engineering use. Due to commercial variations in compositions and to manufacturing limitations, they should not be used for specification purposes. See applicable ASTM International specification references.

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# **Tab C12000**

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## Copperan

## **Search Results**

C12000 (Phosphorus-DeoxIdized, Low Residual P)

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           | Cս <sup>(1)</sup> | Ρ       |
|-----------|-------------------|---------|
| Min./Max. | 99.90 min         | .004012 |
| Nominal   |                   | .008    |

(1) Cu value includes Ag.

**Applicable Specifications** 

| Product                    | Specification                             |
|----------------------------|---|
| Bands, Projectile Rotating | MILITARY MIL-B-20292, MIL-B-18907         |
| Bar                        | ASME SB133<br>ASTM B152<br>SAE J461, J463 |
| Bar, Bus                   | ASTM B187                                 |
| Brazing Filler Metal       | FEDERAL QQ-B-650                          |
| Fittings                   | ASME B16.22                               |
| Foil, Printed Circuits     | ASTM B451                                 |
| Nipples                    | ASTM B687                                 |
| Pipe                       | ASME SB42<br>ASTM B698, B42               |
| Pipe, Bus                  | ASTM B168                                 |
| Plate                      | ASTM B152<br>SAE J461, J463               |
| Rod                        | ASME SB133                                |
| Rod, Bus                   | ASTM B187                                 |
| Shapes                     | SAE J461, J463                            |
| Shapes, Bus                | ASTM B187                                 |
| Sheet                      | ASTM 8152<br>SAE J461, J463               |
| Sheet, Clad                | ASTM B506                                 |
| Sheet, Printed Circuits    | ASTM B451                                 |
| Strip                      | ASTM B152                                 |

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|  | SAE J461, J463  |
|--|---|
| Strip, Clad  | ASTM B506   |
| Strip, Printed Circuits  | ASTM B451   |
| Tube   | ASTM B698, B360   |
| Tube, Bus  | ASTM B188   |
| Tube, Coils  | ASTM B743   |
| Tube, Condenser  | ASME SB111<br>ASTM B111   |
| Tube, Finned   | ASME SB359<br>ASTM B359   |
| Tube, Rectangular Waveguide                                      | ASTM B372<br>MILITARY MIL-W-85  |
| Tube, Seamless   | ASME SB75<br>ASTM B75, B641<br>MILITARY MIL-T-24107<br>SAE J461, J463 |
| Tube, Seamless Bright Annealed                                   | ASTM B68  |
| Tube, Seamless for Air Conditioning and Refrigeration Field Serv | ice SAE J463, J461  |
| Tube, Seamless for Torpedo Use                                   | MILITARY MIL-T-3235   |
| Tube, U-Bend   | ASME SB395<br>ASTM B395   |
| Tube, Welded   | ASTM 8447, B641, B716   |
| Tube, Welded for Air Conditioning and Refrigeration Service      | ASTM 8640   |

### **Common Fabrication Processes**

Blanking, Coining, Coppersmithing, Drawing, Etching, Forming and Bending, Heading and Upsetting, Hot Forging and Pressing, Piercing and Punching, Roll Threading and Knurling, Shearing, Spinning, Squeezing and Swaging, Stamping

**Fabrication Properties** 

| Joining Technique              | Suitability     |
|--------------------------------|-----------------|
| Soldering                      | Excellent       |
| Brazing                        | Excellent       |
| Oxyacetylene Welding           | Fair            |
| Gas Shielded Arc Welding       | Excellent       |
| Coated Metal Arc Welding       | Not Recommended |
| Spot Weld                      | Not Recommended |
| Seam Weld                      | Not Recommended |
| Butt Weld                      | Good            |
| Capacity for Being Cold Worked | Excellent       |
| Capacity for Being Hot Formed  | Excellent       |
| Forgeability Rating            | 65              |
| Machinability Rating           | 20              |

Mechanical Properties (measured at room temperature, 68 F (20 C)

| Temper | Section<br>Size | Cold<br>Work | Typ/<br>Min | Temp | Tensile<br>Strength |     | Strength<br>(0.2% | Yield<br>Strength<br>(0.05%<br>offset) | ξį |   | ckw |     | Vickens<br>Hard. | Brit<br>Hor | nell<br>d. | Shear<br>Strength | Faugue | izod<br>Impact<br>Strangtit |
|--------|-----------------|--------------|-------------|------|---------------------|-----|-------------------|--|----|---|-----|-----|------------------|-------------|------------|-------------------|--------|-----------------------------|
|        | in.             | %            |             | F    | kal                 | ksi | ksi               | kari                                   | Υ, | 8 | Ģ₩  | 30T | 500              | 500         | 3000       | ksi               | ksi    | ñ-lio                       |
|        | mm              |              |             | С    | MPa                 | MPa | MPa               | MPa                                    |    |   | П   | П   |                  | Г           |            | M?a               | MPa    | J.                          |
| Pipe   |                 |              |             |      |                     | _   |                   |  |    |   |     |     |                  |             |            |                   |        |                             |

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|                     | مما  | ا ما   | hual             | سم        | lr o        | Le           |  |           |                | L  | 1             | Ł          |             |     |          | l               |  | h.         |
|---------------------|--|--|------------------|-----------|-------------|--------------|--|-----------|----------------|----|---------------|------------|-------------|-----|----------|-----------------|--|------------|
| 104                 | 0.0<br>0.0                                     | 30   | ТҮР              | 58<br>20  | 50<br>345   | 45<br>310    | <del></del>                                      |           | 10 50<br>10 50 | -  | 901-<br>901-  | ╪          |             | _   | _        | 28<br>193       | ╄  | 0.0<br>0.0 |
| lat Pro             |  | Ш  |                  | 20        | <del></del> | J            | <u>r                                    </u>     |           | V              | Ħ  | ~ <u>r</u>    |            |             |     |          | 133             | <u> </u>   | 0.0        |
| 104                 | 0.25   | 0  | ΤΥP              | 88        | 50          | 45           | F  | -         | 2 50           | F  | 90            | F          |             | , – |          | 28              | F  | 0.0        |
|                     | 3.35   |  |                  | 20        | 345         | 310          |  |           | 250            | -  |               | Ŧ          |             | ,   |          | 193             |  | 0.0        |
| A20                 | 0.25   | 0  | ΤΥP              | 68        | 32          | 10           |  | -         | 50-            | Ħ  | 40            | ╁          | $\neg$      |     |          | 22              | ┼  | 0.0        |
|                     | 6.35   |  | _                | 20        | 221         | 69           | -  |           | 50 ·           | -  | 40            | 1          |             |     | Ì,       | 152             | -  | 0.0        |
| 102                 | 0.04   | 0  | ΤΥΡ              | 68        | 42          | 36           | F  | - 1       | 4 40           | -  | 84 50         | ) -        |             | _   |          | 26              | 13   | 0,0        |
|                     | 1  |  |                  | 20        | 290         | 248          | -  |           | 14 40          | Н  | 84 S          | _          |             |     | _        | 179             | 90   | 0.0        |
| ₹od                 | 1  |  |                  |           |             | <b></b>      |  |           |                | щ  |               |            |             |     | _        |                 | <del></del>                                      | ·          |
| A2C                 | 1  |  | TYP              | 68        | 32          | 10           | <u> </u>   |           | i.5 -          | Π  | 40 ·          | Œ          |             |     |          | 22              | 1  | 0.0        |
|                     | 25,4   |  |                  | 20        | 221         | 69           | ŀ  | - 1       | 55-            | ŀŀ | 40            | ┢          | ŀ           |     | -        | 152             | ŀ  | 0.0        |
| hapet               |  |  |                  |           |             |              |  |           |                |    |               |            |             |     |          |                 |  |            |
| A30                 | 0.5  | 0  | 1YP              |           | 32          | 10           | ٠  |           | 50-            | _  | 40-           | 4          |             |     | •        | 22              | -  | 0.0        |
|                     | 12.7   |  |                  | 20        | 221         | 69           | <u> </u>   |           | 50-            | щ  | 40-           |            |             | •   |          | 152             | <u> </u>   | 0.0        |
| A20                 | 0.5  | 0  | TYP              | _         | 32          | 10           | <u> </u>   |           | 50 -           | н  | 46-           | #          |             | _   | <u> </u> | 22              | -  | 0.0        |
|                     | 12.7   |  |                  | 20        | 221         | 69           | <u> </u>   | <u> </u>  | 50-            | L  | 40-           | <u> </u>   |             |     | <u> </u> | 152             | <u> </u>   | 0.0        |
|                     | oducts<br>loo4                                 | <b>.</b>                                     | trun             | 20        | ko.         | 45           | <del></del>                                      |           | ) E/           | _  | oole.         | , T        | r           |     |          | 20              | 12   | 0.0        |
| 104                 | 0.04   | C  | TYP              | 88<br>20  | 50<br>345   | 45<br>310    | <del></del>                                      |           | 3 50<br>3 50   |    |               | _          |             | _   |          | 28<br>193       | 13<br>90   | 0.0        |
| Jn∢                 | n as   | <u></u>                                      | TVD              |           |             |              | <del>[</del>                                     |           | _              | _  | _             | 4          | <b>;</b>    |     | <u> </u> |                 | 50   | 0.0        |
| 101                 | 0.25   | 0  | TYP              |           | 38          | 30           | f -  |           | 35 25          | П  | _             | Ŧ          |             | •   | 1        | 25              | Ŧ  |            |
| ine                 | 6.35   | 6  | TVP              | 20        | 262         | 207          | <del></del>                                      |           | 35 25          | н  | _             | <u>,</u> † |             | •   | <u> </u> | 172             | <del>[</del> 4                                   | 0.0        |
| 108                 | 0.04   | ř  | TYP              | 68<br>20  | 55<br>379   | 50           | <del>F</del>                                     |           | 60<br>6 BO     |    | 94 6<br>64 6  |            |             | _   | F-       | 29<br>200       | 97   | 0.0        |
| and .               | ľ  | <u> </u>                                     |                  | 20        | 379         | 345          | <u> </u>   | لـــــــا | В              | L  | <b>*</b> P    | 3          |             | •   | •        | 200             | 7,   | u.v        |
| <b>Rod</b><br>08050 | Ti .   | b  | TYP              | 6.8       | 32          | 10           | Γ  |           | 55             | FT | 40            | T          |             | _   |          | 22              | I  | 6.0        |
| 2000                | 25.4   | f  | <u> </u>         | 20        | 221         | 69           | 1  |           | 55 -           | Ħ  | _             | 1          |             |     |          | 152             | t  | 0.0        |
| 104                 | 0.025  | 40   | TYP              |           | 55          | 50           | Ŀ  |           | 20 GO          |    | _             | Ŧ          |             | _   |          | 29              | -{   | 0.0        |
| ,,,,                | 0.64   | Ť  | <del>  '''</del> | 20        | 379         | 345          | t  |           | 20 60          |    |               | 士          |             |     |          | 200             | 1  | 0.0        |
| lat Pr              | oducts   | L  |                  | -         | 5.0         | P-3          | <u> </u>   |           | .0 74          | Ц  | <u> </u>      |            |             | -   |          | 200             | <u>.                                    </u>     | P-v        |
| 104                 | 1  | 0  | ТҮР              | 68        | 45          | 40           | F  | - 1       | 20 45          | FI | 85            | Ŧ          |             |     | ļ        | 26              | F  | 0.0        |
|                     | 25.4   |  |                  | 20        | 310         | 276          | F  |           | 20 45          | П  | 35            | Ŧ          |             | _   |          | 179             | -  | 0.0        |
| 100                 | 0.25   | 0  | ΤÝΡ              | 68        | 36          | 28           | F .  |           | 10 1 D         |    | ōО-           | Ŧ          |             |     | ,        | 25              | F  | 0.0        |
|                     | 6.35   |  |                  | 20        | 248         | 193          | -  | -         | 4 <b>0</b> 10  | П  | 60-           | Ŧ          |             |     |          | 172             | -  | . 0.0      |
| 03050               | 0.25   | o  | TYP              | 68        | 32          | 10           | F  |           | 50 -           |    | 40            | Ŧ          |             |     |          | 22              | -  | 0.0        |
|                     | 5.35   |  |                  | 20        | 221         | 69           | -  |           | 50-            | F  | 40            | Ŧ          |             |     | -        | 152             | -  | 0.0        |
| ₹od                 |  | •  |                  |           |             |              | <u> </u>   |           |                | _  |               |            |             |     |          |                 | •  |            |
| 104                 | 2  | 16   | ΤΥP              | 68        | 45          | 40           |  |           | 20 45          | _  | _             | Ŀ          |             |     |          | 26              | ,  | 0.0        |
|                     | 51   |  |                  | 20        | 310         | 276          | -  |           | 20 45          | ŀ  | 85            | ŀ          |             | _   |          | 179             | -  | 0.0        |
| H04                 | 1  | 15   | TYP              | <b>68</b> | 48          | 44           | <u> </u>   |           | 16 47          | П  | 87            | Ŀ          |             |     |          | 27              | 17   | 0.0        |
|                     | 25.4   |  | L_               | 50        | 331         | 303          | <u> </u>   | -         | 1647           | Ł  | <b>37</b> -   | Ŀ          |             | -   |          | 18 <del>6</del> | 117  | 0.0        |
| ube                 |  |  |                  |           |             |              |  |           |                |    |               |            |             |     |          |                 |  |            |
| 25025               | 0.065  | 0  | TYP              | -         | 34          | 11           | <u> </u>   | _         | 45 ·           | Н  | 45 <u>-</u>   | +          | <del></del> | -   | _        | 23              | +  | 0.0        |
|                     | 1.65   |  | Ļ                | 20        | 234         | 76           | <u> </u>   |           | 15-            | Ц  | 45            | _‡         |             | -   | <u> </u> | 159             | <u> </u>   | 0.0        |
| 180                 | 0.065  | 40   | TYP              |           | 55          | 50           | <del></del>                                      |           | 3 80           |    |               |            |             | ٠   | ▙        | 29              | <del></del>                                      | 0.0        |
| le à                | 1,65   | <u> </u>                                     | _                | 20        | 379         | 345          | <u> </u>   |           | 3 30           |    |               |            |             |     | 느        | 200             | <del> </del>                                     | 0.0        |
| 155                 | 0.065  | 15   | ТҰР              | _         | 46          | 32           | <del> </del>                                     |           | 2535           | _  | _             | _          |             | •   | -        | 26              | <del> </del>                                     | 0.0        |
|                     | 1.65   | L  | <u> </u>         | 20        | 276         | 221          | <u> </u>   |           | 25 35          | L  | 77 <b> </b> 4 | ő -        |             | •   |          | 179             | <u> </u>   | G.0        |
| lat Pr<br>420       | 0.04   | 0  | İΤΥΡ             | KA.       | 34          | 10           | L  |           | s GL           | _  | 45            | T          |             | _   |          | 23              | L  | 0.0        |
| n.CV                | 1  | f  | 11.7             | 20<br>20  | 234         | 69           | <del>[                                    </del> |           | 15 -<br>15 -   | Н  |               | Ŧ          | -           |     |          | 23<br>159       | <del>[                                    </del> | 0.0        |
| haper               | <u>l'                                     </u> | <u>.                                    </u> | L_,              | ۴V        | <u> </u>    | Ľ'           | <u> </u>   | LI        | ' <b>-</b> ['  | L  | <u>'T</u>     |            |             |     |          | 1.00            | <u> </u>   | ۷.۷        |
| )S050               |  | 0  | TYP              | 58        | 32          | 10           | Ţ.   | -         | 50F            | П  | 40            | Ţ          | ī           |     |          | 22              | F.   | 0.0        |
|                     | 12.7   |  | Ė                | 20        | 221         | 69           | <del>                                     </del> |           | 50 ·           |    | 40            | 丰          |             |     |          | 152             | 1  | 0.0        |
| lat Pr              | oducts   |  |                  |           | <u> </u>    | <del>'</del> | <u> </u>   |           |                | Ц  |               |            |             |     | L        |                 | 1  | 1          |
| )S050               |  | C  | ΙΥΡ              | 68        | 32          | 10           | ŀ  | E I       | 15-            | Ū  | 4Ú-           | ŀ          |             |     |          | 32              | F  | 0.0        |
|                     | 1  |  | Γ                | 20        | 221         | 69           | 1  |           | 15 ·           |    | 40-           | Ŧ          |             |     |          | 221             | <u> </u>   | C.O        |
| hape                |  |  |                  |           | •           | <del></del>  |  |           |                | ۲  |               |            |             |     |          |                 |  | •          |
| 104                 | 0.5  | 15   | TYP              | 88        | 40          | 32           | <u> </u>   |           | 30 35          | IJ | . J.          | ŀ          |             |     |          | 23              | F  | 0.0        |
|                     | 12,7   |  |                  | 20        | 276         | 221          | F  | - 1       | 30 35          | П  | F             | Ŧ          |             | -   | -        | 156             | F  | 0.0        |
| ube                 |  |  |                  |           |             |              |  |           |                | _  |               |            |             |     |          |                 |  |            |
|                     | 0.065  | O  |                  |           |             | 10           |  |           | 15-            |    |               |            |             |     |          | 22              |  | 0.0        |

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|          | 1,65  | 1   | 1   | 20 | 221 | 69  | 1   | ŀ        | J. | +  | H | 40 | ŀ   | ŀ        | ŀ | F  | 152 | F  | 0.0 |
|----------|-------|-----|-----|----|-----|-----|-----|----------|----|----|---|----|-----|----------|---|----|-----|----|-----|
| Flat Pro | ducte |     |     |    | _   |     |     |          | -  |    |   |    |     |          |   |    |     |    |     |
| OS025    | 0.04  | þ_  | TYP | 58 | 34  | 11  | ŀ   |          | 4: | Ł  | - | 15 | E   | <u> </u> | Ŀ |    | 23  | 11 | 0.0 |
|          | 1     | T   |     | 20 | 234 | 76  | F   | ŀ        | 4  | Ŧ  | ŀ | 45 | ┡   | ┡        | ŀ | Į. | 159 | 76 | O.0 |
| H01      | 0.04  | 0_  | TYP | 66 | 38  | 30  | -   | <u> </u> | 2  | 21 | Ł | 70 | 38  | F        |   | F  | 25  |    | 0,0 |
|          | h     | Т   | Т   | 20 | 262 | 207 | - 1 | -        | 2: | 2: | Ŧ | 70 | 36  | ļ        | Ŧ | F  | 172 | 1  | 0.5 |
| HOO      | 0,04  | D D | TYP | 66 | 36  | 28  | -   |          | 31 | 1( | ī | 80 | 25  | F        | Ŧ | Ŧ  | 25  | F  | 0.0 |
|          | 1     |     |     | 20 | 248 | 193 | -   |          | 3  | 10 | 1 | 50 | 2.5 | F        | - | F  | 172 | -  | 0.0 |
| H10      | 0.04  | b   | TYP | 68 | 57  | 53  | 1   | -        | 4  | 62 | Έ | 95 | 64  |          | Ŧ | Ī  | 29  |    | 0.0 |
|          | 1     | Т   |     | 20 | 393 | 365 | -   | -        | 4  | Đ2 | 1 | 95 | 64  | -        | - | Ŧ  | 200 | 1  | 0.0 |

<sup>\*</sup>Fatigue Strength: 100 x 10 <sup>6</sup>cycles, unless indicated as [N]X 10<sup>8</sup>.

**Physical Properties** 

|                                  | US Customary  | Metric                                   |
|----------------------------------|---|--|
| Melting Point - Liquidus         | 1981 F  | 1083 C                                   |
| Melting Point - Solidus          | 1981 F  | 1083 C                                   |
| Density                          | 0.323 lb/in <sup>3</sup> at 68 F                    | 8.94 gm/cm <sup>3</sup> @ 20 C           |
| Specific Gravity                 | 8.94  | 8.94                                     |
| Electrical Resistivity           | 10.6 ohms-cmil/ft @ 68 F                            | 1.76 microhm-cm @ 20 C                   |
| Electrical Conductivity*         | 98 %IACS @ 68 F                                     | 0.573 MegaSiemens/cm @ 20 C              |
| Thermal Conductivity             | 223.0 Btu · ft/(hr · ft2.0F)at 68F                  | 386.0 W/m · °K at 20 C                   |
| Coefficient of Thermal Expansion | 9.4 ·10 <sup>-6</sup> per °F (68-212 F)             | 16.9 ·10 <sup>-6</sup> per °C (20-100 C) |
| Coefficient of Thermal Expansion | 9.6 ·10 <sup>-6</sup> per °F (68-392 F)             | 17.3 ·10 <sup>-6</sup> per °C (20-200 C) |
| Coefficient of Thermal Expansion | 9.8 ·10 <sup>-6</sup> per <sup>o</sup> F (68-572 F) | 17.6 ·10 <sup>-6</sup> per °C (20-300 C) |
| Specific Heat Capacity           | 0.092 8tu/lb/°F at 68 F                             | 393.5 J/kg · °K at 293 K                 |
| Modulas of Elasticity in Tension | 17000 ksi   | 117000 MPa                               |
| Modulus of Rigidity              | 6400 ksi  | 44130 MPa                                |

<sup>&</sup>quot;Volume and weight basis.

**Tempers Most Commonly Used** 

| Flat Products |                                   |
|---------------|-----------------------------------|
| PLATE         | H00, OS050                        |
| SHEET         | H00, H01, OS050                   |
| STRIP, ROLLE  | DH00, H01, H04, H06, OS035, OS050 |

| Other                    |                   |
|--------------------------|-------------------|
| PIPE H04, H58, O60       |                   |
| TUBE H04, H55, H58, H80, | O60, OS025, OS050 |

### Typical Uses

Architecture

Flashing, Architectural Trim, Roofing

Electrical

Tubular Bus, Busbars (Welded or Brazed)

Industrial

Welded Tube, Tubing, Medical Gas-Oxygen, Conductors, Resistance Welding Equipment, Tubing, LP Gas Service

Other

Applications Requiring Welding or Brazing

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The values listed above represent reasonable approximations suitable for general engineering use. Due to commercial variations in compositions and to manufacturing limitations, they should not be used for specification purposes. See applicable ASTM International specification references.

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6/23/2008

# **Tab C12200**

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# Copper.ca

主境 奇式的过去分词形式 美罗普拉美国机构单位数主要领导 机砂 似似色细 增加指数

## **Search Results**

C12200 (Phosphorus-Deoxidized, High Residual P)

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           | Cu       | Р       |
|-----------|----------|---------|
| Min./Max. | 99.9 min | .015040 |
| Nominal   | _        | .02     |

Note: This includes oxygen-free Cu which contains P in an amount agreed upon.

Applicable Specifications

| Product                      | Specification  |
|------------------------------|--|
| Bands, Projectile Rotating   | MILITARY MIL-B-18907, MIL-B-20292                      |
| Bar                          | ASME SB152, SB133<br>ASTM B187, B152<br>SAE J463, J461 |
| Brazing Filler Metal         | FEDERAL QQ-B-650                                       |
| Fittings                     | ASME B16.29, B16.22                                    |
| Nipples                      | ASTM B687  |
| Pipe                         | ASME SB42<br>ASTM B42, B698                            |
| Pipe, Threadless (Seamless)  | ASTM B302  |
| Plate                        | ASME SB152<br>ASTM B152                                |
| Plate, Clad                  | ASTM B432  |
| Rod                          | ASME SB133<br>SAE J463, J461                           |
| Shapes                       | ASTM B187<br>SAE J461, J463                            |
| Sheet                        | ASME SB152<br>ASTM B152<br>SAE J461, J463              |
| Sheet, Building Construction | ASTM B370  |
| Sheet, Clad                  | ASTM B506  |
| Sheet, Lead Coated           | ASTM B101  |
| Strip                        | ASME SB152   |

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|   | ASTM B152, B272   |
|---|---|
| Out Dark Out of   | SAE J463, J461  |
| Strip, Building Construction  | ASTM B370   |
| Strip, Clad   | ASTM B506   |
| Tube  | ASTM B698, B903   |
| Tube, Capillary   | ASTM B360   |
| Tube, Coils   | ASTM B743   |
| Tube, Condenser   | ASME SB111<br>ASTM B111   |
| Tube, Drainage (DWV)  | ASTM B306   |
| Tube, Finned  | ASME SB359<br>ASTM B359<br>MILITARY MIL-T-22214                       |
| Tube, Seamless  | ASME SB75<br>ASTM B75, B641<br>MILITARY MIL-T-24107<br>SAE J461, J463 |
| Tube, Seamless (Water)  | ASTM B88  |
| Tube, Seamless Bright Annealed                                      | ASTM B68  |
| Tube, Seamless for Air Conditioning and Refrigeration Field Service | ASTM B280<br>SAE J461, J463   |
| Tube, Seamless for Torpedo Use                                      | MILITARY MIL-T-3235   |
| Tube, U-Bend  | ASME SB395<br>ASTM B395   |
| Tube, Welded  | ASME SB543<br>ASTM B641, B447, B716, B543                             |
| Tube, Welded for Air Conditioning and Refrigeration Service         | ASTM B640   |
| Wire, Flat  | ASTM B272   |

### **Common Fabrication Processes**

Blanking, Coining, Coppersmithing, Drawing, Etching, Forming and Bending, Heading and Upsetting, Hot Forging and Pressing, Piercing and Punching, Roll Threading and Knurling, Shearing, Spinning, Squeezing and Swaging, Stamping

**Fabrication Properties** 

| Joining Technique              | Suitability     |
|--------------------------------|-----------------|
| Soldering                      | Excellent       |
| Brazing                        | Excellent       |
| Oxyacetylene Welding           | Good            |
| Gas Shielded Arc Welding       | Excellent       |
| Coated Metal Arc Welding       | Not Recommended |
| Spot Weld                      | Not Recommended |
| Seam Weld                      | Not Recommended |
| Butt Weld                      | Good            |
| Capacity for Being Cold Worked | Excellent       |
| Capacity for Being Hot Formed  | Excellent       |
| Forgeability Rating            | 65              |
| Machinability Rating           | 20              |

Mechanical Properties (measured at room temperature, 68 F (20 C)

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| Temper   | Section<br>Size | Cold<br>Work | Typ/<br>Min                  | Temp     | Tensile<br>Strength | Yleid<br>Strength<br>(0.5% ext.<br>under load | Yield<br>Strongth<br>(0.2%<br>offset) | Yield<br>Strength<br>(0.05%<br>offset) | Ei          | Ro<br>Ha |          |    |                | Vickens<br>Hard. | Bri<br>Hai |          | Shear<br>Strength | Fatigue<br>Strength                            | izod<br>Impaci<br>Strength                   |
|----------|-----------------|--------------|------------------------------|----------|---------------------|---|---------------------------------------|--|-------------|----------|----------|----|----------------|------------------|------------|----------|-------------------|--|--|
|          | in.             | ×            |                              | F        | ksi                 | ksí   | ksi                                   | ksi                                    | *           | 3        | c        | F  | DOT            | 500              | 500        | 3000     | ksi               | ksi  | #45  |
|          | mm.             |              |                              | v        | MPa                 | MPa   | MPa                                   | мРа                                    | r           | T        | r        | t  | T              |                  | T          |          | MPa               | мРа  | l .  |
| Pipe     |                 |              |                              |          |                     | ·   | <del></del>                           |  | _           | ٠.       | ٠.       | _  | _              |                  | _          | 1        | -                 |  | <u> </u>                                     |
| H04      | 0.0             | 30           | TYP                          | 88       | 50                  | 45  | 1                                     | L                                      | 10          | 50       | t        | 90 | 1              | ļ —              | Γ_         | Į.       | 28                | F  | 0.0  |
|          | 0.0             |              | _                            | 20       | 345                 | 310   |                                       |  | -           | 50       | •        | -  | _              |                  | Г          |          | 193               |  | 0.0  |
| Flat Pro |                 |              | ــــــ                       | <u> </u> |                     |   | <u> </u>                              |  | _           |          | <u> </u> |    | 1              |                  | <u> </u>   | <u> </u> |                   | <u> </u>                                       | -·• ·  |
| H04      | 0.25            | b            | TYP                          | 68       | 50                  | 45  | F                                     | ļ                                      | 12          | 50       | Ī        | 90 | yl.            |                  | ī.         | ī        | 28                | F  | 0.0  |
|          | 5.35            |              |                              | 20       | 345                 | 310   | -                                     | 1                                      | _           | 50       | -        | _  | _              |                  | ┡          | t        | 193               |  | 0,0  |
| M20      | 0.25            | 0            | ΤΥΡ                          | 68       | 32                  | 10  | -                                     | -                                      | 50          | _        |          | 40 |                |                  | ┢          |          | 22                |  | 0.0  |
|          | 6.35            |              |                              | 20       | 221                 | 69  | <u> </u>                              |  | 50          | _        | -        | 40 | _              |                  |            |          | 152               |  | 0.0  |
| H02      | 0.04            | 0            | ΤΫ́Ρ                         |          | 12                  | 36  | _                                     |  |             |          | ١.       | _  | 50             | t                | H          | t        | 26                | 13   | 0.0  |
|          | 7               | Ì            | · ·                          | 20       | 290                 | 248   |                                       |  | _           | _        | •        | -  | 50             |                  | Н          |          | 179               | 90   | 0.0  |
| H04      | 0.94            | 0            | TYP                          |          | 50                  | 45<br>45                                      | L                                     | <del> </del>                           | 10          | -        | -        | -  | 357            |                  | ┡          | ├        | 28                | 13   | 0.0  |
|          |                 | F            |                              | 20<br>20 | 345                 | 310   | <del> </del>                          | Ι                                      | _           | 50       | -        | -  | 157<br>157     | lacksquare       | F          | f        | _                 | 90   |  |
| H01      | 1 2 E           | -            | -22                          |          |                     |   | <del>[</del> -                        | <del></del>                            | _           | 1_       |          | _  | _              | ľ                | H          | <u> </u> | 193<br>26         | <del>ου</del>                                  | 0.0  |
| 101      | 0.25            | 0            | ΤΥP                          |          | 38                  | 30  | <u> </u>                              | <del></del>                            |             | 25       |          | 70 | _              | <del></del>      | ٢          | -        | 25                | <del>-</del>                                   | 0.0  |
|          | 6.35            | <u> </u>     | ****                         | 20       | 252                 | 207   | <u> </u>                              | <u> </u>                               | _           | 25       | -        | 70 | -              | <u> </u>         | Ļ.         | <u> </u> | 172               |  | 0.0  |
| H06      | 0.04            | <u>e</u>     | TYP                          |          | 55                  | 50  | -                                     | <del>-</del>                           | +           | 60       | •        | _  | 63             | <u> </u>         | ₽          | <u> </u> | 29                | 14   | 0,0  |
|          | 1               | <u> </u>     | _                            | 20       | 370                 | 345   | -                                     |  | 4           | 60       | -        |    | 83             | <u> </u>         | 辶          | _        | 200               | 97   | 0.0  |
| H04      | 1               | P            | TYP                          | _        | 45                  | 40  | <u> </u>                              | ·                                      | -           | 45       | -        | 8. |                | <u> </u>         | Ł          | <u> </u> | 26                |  | 0.0  |
|          | 25.4            |              | L .                          | 20       | 310                 | 278   | -                                     | <u> </u>                               | _           | 45       | _        | 35 | _              | -                | <u> </u>   | <u> </u> | 179               | <u>-                                      </u> | 0.0  |
| H00      | 0.25            | 0            | TYP                          | 68       | 38                  | 28  | <u> </u>                              | <u> </u>                               | -           | 10       | -        | -  | -              |                  | 느          | <u> </u> | 25                | -  | 0,0  |
|          | Б.35            |              |                              | 20       | 248                 | 193   | -                                     | <u> </u>                               | <b>\$</b> 0 | 10       | Ŀ        | 80 | <u> </u>       |                  | -          | -        | 172               | -  | 0.0  |
| OS050    | 0.25            | C            | TYP                          | 68       | 32                  | 10  | ٠                                     | - "                                    | 50          | Ŀ        | ŀ        | 40 | <b>}</b>       |                  | E          | Ł        | 22                | ŀ  | 0.0  |
|          | 6.35            | ł            |                              | 20       | 221                 | 69  | ŀ                                     | 1                                      | 50          | ╁        | ŀ        | 40 | <b>i</b>       | ŀ                | ┡          | ŀ        | 152               | -  | 0,0  |
| Tube_    |                 |              |                              |          |                     |   |                                       |  |             |          |          |    |                |                  |            |          |                   |  |  |
| OS025    | 0.065           | D            | TYP                          | 69       | 34                  | 11  | -                                     | -                                      | 45          | Ŀ        | Ŀ        | 45 | 1              |                  | Ŀ          | <u> </u> | 23                |  | 0.0  |
|          | 1.65            | <u> </u>     |                              | 20       | 234                 | 76  | <b>-</b> .                            | ŧ.                                     | 45          | Ł        | Ŀ        | 45 | *              | _                | ŀ          | Ι.       | 159               | ŀ  | 0.0  |
| H80      | 0.065           | 40           | TYP                          | 68       | 65                  | 50  | F                                     | Ł.,                                    | ð           | 60       | E        | 96 | 63             |                  | E          | F        | 29                | 19   | 0.0  |
|          | 1.65            | •            |                              | 20       | 379                 | 345   | -                                     | ŀ                                      | θ           | Ġû       | ł        | 95 | <b>5</b> 3     | ŀ                | ┡          | ŀ        | 200               | 131  | 0.0  |
| H55      | 0.085           | 15           | TYP                          | 68       | 10                  | 32  | -                                     | Ļ                                      | 25          | 35       | Ē        | 77 | 45             |                  |            | -        | 26                | 14   | 0.0  |
|          | 1.65            |              |                              | 20       | 276                 | 221   | -                                     |  | 25          | 35       | F        | 77 | 45             | F                | F          |          | 179               | 97   | 0.0  |
| Flat Pro | ducts           |              |                              |          | t                   |   |                                       |  | ۰           | _        |          | _  |                |                  |            | <u> </u> | ·                 | •  | <u>.                                    </u> |
| M20      | 0.04            | þ            | TYP                          | 68       | 34                  | 10  | -                                     | -                                      | 45          |          | E        | 46 | 1              |                  | F          | -        | 23                | -  | 0.0  |
|          | 1               | l ~          | j                            | 20       | 234                 | 69  | -                                     | } <u> </u>                             | 45          | F        | F        | 45 | +              | -                | ŀ          | -        | 159               | -  | 0.0  |
| OS050    | 0.04            | 0            | тур                          | 68       | 32                  | 10  | -                                     | -                                      | 45          | E        | Ľ        | 40 | 1              |                  | Ŀ          |          | 22                |  | 0.0  |
|          | 1               |              |                              | 20       | 221                 | 59  |                                       | -                                      | 45          | F        | F        | 40 | 1              | -                | F          | F        | 152               | F  | 0.0  |
| Tube     |                 |              |                              |          |                     |   |                                       |  |             | _        | _        | _  |                |                  | •          |          |                   |  | ·  |
| OS050    | 0.065           | 0            | TYP                          | 88       | 32                  | 10  | F                                     | F                                      | 45          | E        | E        | 40 | X_             | - :              | E          | Ŀ        | 22                | 11   | 0.0  |
|          | 1.65            |              |                              | 20       | 221                 | 69  | -                                     | -                                      | 45          | F        | F        | 40 | <b>-</b>       | -                | F          |          | 152               | 76   | 0.0  |
| Flat Pro | ducts           |              |                              |          |                     |   |                                       |  | _           | _        | _        | _  | _              |                  | _          |          |                   |  |  |
| OS025    | G.04            | 0            | TYP                          | 68       | 34                  | 11  | F                                     | E                                      | 45          | Ē        | E        | 45 | L              |                  | E          | Ė        | 23                | 11   | 0.0  |
| l _ "    | 1               | L            | L                            | 20       | 234                 | 76  | -                                     | }                                      | 45          | -        | F        | 45 | <del>∤</del> ¯ | -                | F _        | -        | 159               | 76   | G.Q  |
| H00      | 0.04            | 0            | TYP                          | 68       | 36                  | 28  | -                                     | E                                      |             |          |          |    | 25             |                  | E          | F_       | 25                |  | ć.o  |
|          | 1               |              |                              | 20       | 248                 | 193   | <u> </u>                              | -                                      |             |          |          |    | 25             |                  | F          | F        | 172               |  | 0.0  |
| H01      | 0.04            | 0            | ΤΥΡ                          |          | 3B                  | 30  | -                                     | ļ .                                    |             |          |          |    | 236            |                  | ┢          | ┞        | 25                |  | 0.0  |
|          | 1               |              |                              | 20       | 262                 | 207   | F                                     | 1                                      |             |          |          |    | 36             |                  |            |          | 172               |  | 0,0  |
| H10      | 0.04            | 0            | ΤΫ́P                         |          | 57                  | 53  | _                                     |  | _           |          |          |    | 64             |                  | ⊨          |          | 29                |  | 0.0  |
|          | 1               |              |                              | 20       | 393                 | 365   | t                                     |  | _           | _        | _        | _  | 54             |                  |            | t        | 200               |  | C.O  |
|          | ·               | <u> </u>     | $ldsymbol{ldsymbol{\sqcup}}$ | <u> </u> |                     |   |                                       | <u> </u>                               | _           | Ľ        | Ĺ.       | ľ  | T'             |                  | <u> </u>   |          | r.~               |  |  |

<sup>\*</sup>Fatigue Strength:  $100 \times 10^{6}$ cycles, unless indicated as [N]X  $10^{6}$ .

### **Physical Properties**

|                          | US Customary | Metric |  |
|--------------------------|--------------|--------|--|
| Melting Point - Liquidus | 1981 F       | 1083 C |  |
|                          |              |        |  |

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| Density                          | 0.323 lb/in <sup>3</sup> at 68 F                    | 8.94 gm/cm <sup>3</sup> @ 20 C            |
|----------------------------------|---|---|
| Specific Gravity                 |   | 8.94                                      |
| Electrical Resistivity           | 12.2 ohms-cmil/ft @ 68 F                            | 2.03 microhm-cm @ 20 C                    |
| Electrical Conductivity          |   | 0.497 MegaSiernens/cm @ 20 C              |
| Thermal Conductivity             | 196.0 Btu · ft/(hr · ft2-ºF)at 68F                  |   |
| Coefficient of Thermal Expansion |   | 16.9 ·10 <sup>-6</sup> per °C (20-100 C)  |
| Coefficient of Thermal Expansion | 9.5 ·10 <sup>-6</sup> per <sup>o</sup> F (68-392 F) | 17.1 · 10 <sup>-6</sup> per °C (20-200 C) |
| Coefficient of Thermal Expansion | 9.8 -10 <sup>-6</sup> per <sup>o</sup> F (68-572 F) | 17.6 ·10 <sup>-6</sup> per °C (20-300 C)  |
| Specific Heat Capacity           | 0.092 Btu/lb/ºF at 68 F                             | 393.5 J/kg · °K at 293 K                  |
| Modulas of Elasticity in Tension | 17000 ksi   | 117000 MPa                                |
| Modulus of Rigidity              | 6400 ksi  | 44130 MPa                                 |

### **Tempers Most Commonly Used**

| Flat Products |            |
|---------------|------------|
| PLATE         | M20, OS050 |
| SHEET         | M20, OS050 |
| STRIP, ROLLED | OS050      |

| Other |                             |
|-------|-----------------------------|
| PIPE  | H04                         |
| ROD   | H04, OS050                  |
| TUBE  | H55, H58, H80, OS025, OS050 |

### Typical Uses

Architecture

Roofing, Flashing, Downspouts, Gutters

Automotive

Oil Lines, Air Lines, Hydraulic Lines

Building

Heater Lines, Gas Lines, Air Conditioner Tubes and Condenser Sheets, Heater Units, Oil Burner Tubes

Consumer

Refrigerators, Air Conditioners

Electrical

Wire Connectors, Heater Elements

Industrial

Gage Lines, Rotating Bands, Oil Lines in Airplanes, Hydraulic Lines in Airplanes, Gasoline Lines in Airplanes, Air Lines in Airplanes, Oil Coolers in Airplanes, Tanks, Water Lines, Steam Lines, Paper Lines, Pulp Lines, Distiller Tubes, Dairy Tubes, Heat Exchanger Tubes, Evaporator Tubes, Condenser Tubes, Brewery Tubes, Sugar House Refinery Lines, Print Rolls, Paper Rolls, Expansion Joint Tubes, Plating Hangers, Plumbing Tube, Plating Anodes, Plating Racks, Plating Anodes, Casting Molds, Tubing, LP Gas Service, Tubing, Medical Gas-Oxygen, Kettles, Anodes for Electroplating, Heat Exchanger Shells

Marine

Gasoline Lines, Oil Coolers

Plumbing

Plumbing Pipe, Plumbing Fittings

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The values listed above represent reasonable approximations suitable for general engineering use. Due to commercial variations in compositions and to manufacturing limitations, they should not be used for specification purposes. See applicable ASTM International specification references.

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# **Tab C14500**

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# Copperun

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### Search Results

C14500 (Tellurium-Bearing)

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           | Cu <sup>(1)(2)</sup> | P       | Te   |
|-----------|----------------------|---------|------|
| Min./Max. | 99.90 min            | .004012 | 40-7 |
| Nominal   | 99.50                | .008    | 55   |

(1) Cu value includes Ag.

(2) Includes Te + P.

Note: Includes oxygen-free or deoxidized grades with deoxidizers (such as phosphorus, boron, lithium or others) in an amount agreed upon.

Applicable Specifications

| Product              | Specification               |
|----------------------|-----------------------------|
| Bar                  | ASTM B301                   |
| Bar, Forging         | ASTM B124                   |
| Brazing Filler Metal | FEDERAL QQ-B-650            |
| Fittings             | ASME B16.22                 |
| Forgings, Die        | ASTM B283                   |
| Rod                  | ASTM B301<br>SAE J461, J463 |
| Rod, Forging         | ASTM B124                   |
| Shapes               | ASTM B301                   |
| Shapes, Forging      | ASTM B124                   |
| Shapes, Refinery     | ASTM B216                   |
| Wire                 | ASTM B301                   |

### **Common Fabrication Processes**

Cold - Drawing, machining, moderate cold heading, Hot - Extrusion, forging (closed die only)

**Fabrication Properties** 

| Joining Technique    | Suitability |
|----------------------|-------------|
| Soldering            | Excellent   |
| Brazing              | Good        |
| Oxyacetylene Welding | Fair        |
|                      |             |

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| Gas Shielded Arc Welding       | Fair            |
|--------------------------------|-----------------|
| Coated Metal Arc Welding       | Not Recommended |
| Spot Weld                      | Not Recommended |
| Seam Weld                      | Not Recommended |
| Butt Weld                      | Fair            |
| Capacity for Being Cold Worked | Good            |
| Capacity for Being Hot Formed  |                 |
| Forgeability Rating            | 65              |
| Machinability Rating           | 85              |

| len)per                  | Section<br>Size | Cold<br>Work | Typ/<br>Min                                  | Temp           | Tensila<br>Strength | Yield<br>Strength<br>(0.5% ext.<br>under load)     |  | Yield<br>Strength<br>(0.05%<br>offset)           | Ē        | k.         | oci<br>ard | kw | 0  <br> \$\$ | Vickens<br>Hard.                                   | Bri<br>Hai                                   | netl<br>rd.                                  | Shear<br>Strength | Fatigue<br>Strength                              | izod<br>Impact<br>Strengi |
|--------------------------|-----------------|--------------|--|----------------|---------------------|--|--|--|----------|------------|------------|----|--------------|--|--|--|-------------------|--|---------------------------|
|                          | in,             | %            |  | F              | ksi                 | icsi   | kal  | ksi  | *        | F          | ŀ          | F  | 30T          | 500  | 500  | 3000   | ksi               | ksi  | ft⊲b                      |
|                          | mm.             |              |  | c              | MPa                 | MPa  | MPa  | мра  |          |            |            |    |              |  |  |  | МРа               | MPa  | ļ                         |
| ₹od                      |                 |              |  | Y              |                     |  |  |  |          |            |            |    | γ-           | ·  | _  | _  | h.c               | 1  | 0.0                       |
| 102                      | 2               | 15           | TYP  | 68             | 42                  | 39   | <u> </u>   | <u> </u>   | 35       | -          | ŀ          | ŀ  | ŀ            |  | Ł  | ř-   | 25                |  | +                         |
|                          | 51              | <u> </u>     |  | 20             | 290                 | 269  | <u> </u>   | <u> </u>   | 35       | <b>1</b> — | L          | L. | _            | <u> </u>   | L  | <u> </u>                                     | 172               |  | 0.0                       |
| S015                     | 0.5             | <u> </u>     | 鱼  | 68             | 33                  | 11   | <u> </u>   | <del>-</del>                                     | 46       | •          | •          | 22 | _            | -  | ┢  | ╄┯   | 22                |  | 0.0                       |
|                          | 12.7            |              |  | 20             | 228                 | 76   | <u> </u>   | <u> </u>   | 46       | _          |            | 43 | _            |  | F  | <u>;                                    </u> | 152               | <u> </u>   | 0.0                       |
| 100                      | 0.5             | 6            | TYP  | 88             | 38                  | 30   | <del></del>  | İ  | -        | -          | ŧ          | ŀ  | 44           | <del>-</del>                                       | H  | <del>-</del>                                 | 25                |  | 0.0                       |
|                          | 12.7            | <u> </u>     | <u> </u>                                     | 20             | 262                 | 207  | <u> </u>   | <u> </u>   | 26       | 36         | ł          | L  | 44           |  | r  | <u> </u>                                     | 172               | <u> </u>   | 0.0                       |
| VIre                     | <b>1</b> 0.00   | L            | byc  | le e           | he                  | ho   |  | _  | ho       |            | •          | _  | Т            |  | •  | T  | 25                | Г  | 0.0                       |
| 100                      | 0.08            | 0            | TYP  | 68             | 38                  | 30   | <del></del>  | <del></del>                                      | 20<br>20 | -          | ŧ          | F  | F            | <del>[                                    </del>   | ╄  | f  | 172               |  | 0.0                       |
|                          | <u> </u>        | <u> </u>     | <u> </u>                                     | 20             | 262                 | 207  | r  | <u> </u>   | ۲        | 1          | ŀ          | ţ  | <u>t_</u>    | <u> </u>   | ľ  | <u>l</u>                                     | 1172              | <u> </u>   | I <sup>3.0</sup>          |
| 10d                      | 0.5             | 75           | TYP  | la o           | 48                  | 44   | I.   | T .  | l s      | 46         | ī          | τ  | t            | L  | _  | _  | 27                | Į.   | 0.0                       |
| 104                      |                 | 35           | 1119   | 68             |                     | 303  | F  | <del></del>                                      | 15       | t          | 1          | f  | ſ            | f —  | f  | ſ  | 186               | <del>                                     </del> | 0.0                       |
| 100                      | 12.7            | 20           | TYP  | 20             | 331                 | D03  | ├  | <del></del>                                      | _        | _          | ╁          | F  | ₽            | F  | ₽  | ╌  | 26                | <del></del>                                      | 0.0                       |
| 102                      | 0.25            | 20           | 1 41   | 58             | <del></del>         | <del></del>  | <del></del>  | <del></del>                                      | •        | -          | •          | -  | ₽            | F  | ╀  | ╌  | 179               |  | 0.0                       |
| 100                      | 6,35            |              | 51.414                                       | 20             | <u> </u>            | <u> </u>   |  | •  | _        | 43         | 1          | Ļ  | ╄            |  | ŀ  | <del> </del>                                 | 11/8              |  | 0.0                       |
| 102                      | .25             | 0            | SMIN   | •              | 38                  | 30   | <del>†                                      </del> | <del>-</del>                                     | 12       | -          | ÷          | ŀ  | ١            | ŧ  | ╄  | ╄  | f —               | <del></del>                                      | 0.0                       |
|                          | 6.35            | <u> </u>     |  | 20             | 260                 | 205  | <u> </u>   | <u> </u>   | 12       | _          | Ļ          | ŧ. | <u> </u>     | <del> </del>                                       | ļ.   | <u> </u>                                     | <u></u>           | <u> </u>   | 0.0                       |
| D\$050                   |                 | C            | TYP  | 68             | 32                  | 10   | <del> </del>                                       | ╌  | S        | -          | -          | 40 | -            | ┡  | ╄  | ╄  | 22                | <del></del>                                      | +                         |
|                          | 25.4            | <u> </u>     | <u> </u>                                     | 20             | 221                 | 69   | <u> </u>   | <u> </u>   | 60<br>2  | _          | 1          | 40 | -            | <u> </u>   | 1  | <u> </u>                                     | 152               | <u> </u>   | 0.0                       |
| 104                      | 1               | 35           | ΪΫΡ  | 68             | 48                  | 44   | <del>}                                    </del>   | <del> </del>                                     | 1        | Т          | Ŧ          | ŀ  | ÷            | <del> </del>                                       | ╀  | <del>!</del>                                 | 27                | <del></del>                                      | 0.0                       |
|                          | 25,4            | 辶            | <u> </u>                                     | 20             | 331                 | 303  | <u> </u>   |  | Ľ        | _          | _          | Ļ  | Ł            | <u> </u>   | Ļ  | 上  | 186               | <u> </u>   | 0.0                       |
| H02                      | 0.5             | 20           | TYP  | 68             | 43                  | 40   | <u> </u>   | <del>!                                    </del> | 2.5      | •          | •          | •  | 50           | <del>!                                      </del> | ╄  | ╄  | 25                | <del>-</del>                                     | 0.0                       |
|                          | 127             | _            | ļ  | 20             | 296                 | 276  | <u> </u>   | <u> </u>   | 20       | 1          | Ł          | Ļ. | 50           | ᆣ  | <u></u>                                      | ╄  | 179               | <u> </u>   | 0.0                       |
| 102                      | 0.25            | 20           | SMin   | _              | 38                  | 40   | <u> </u>   | <u> </u>   | Ė        | Ł          | ŧ          | ŀ  | Ł            | <u> </u>   | ╄  | ╄  | <u> </u>          | <u> </u>   | 0,0                       |
|                          | 6.35            | L            |  | 20             | 296                 | 276  | <u> </u>   | <u> </u>   | -        | Ŀ          | ŀ          | ŀ  | ŀ            | <u>t</u>   | ٠  | r  | <u> </u>          | -  | 0.0                       |
| Tube                     | L               | 1            |  |                | T. a                | L.   |  |  | La.      | J.,        | -T         | _  |              |  | _  |  | b.                |  | lo o                      |
| H55                      | 0.065           | 15           | ТҮР  | 68             | 40                  | 32   | <del>                                     </del>   | <del> </del>                                     | -        | r          | -          | ÷  | Ł            | ŧ –  | ╌  | ١  | 24                |  | 0.0<br>0.0                |
|                          | 1.65            |              | L  | 20             | 278                 | 721  | <u> </u>   | <u> </u>   | Ľ        | þ.         | 1          | Ľ. | <u>t</u>     | <u>t                                    </u>       | ŀ.   | <u>t</u> .                                   | 165               | <u> </u>   | 0.0                       |
| Rod                      | L               | 20           | TYP  | 88             | 42                  | 40   | 1  | <del></del>                                      | h        | k:         | 1          | Τ. | 1            | 1  | 1  | 1  | 25                |  | 0.0                       |
| 102                      | 1               | 20           | 1177   | 20             | 290                 | <del>1</del>                                       | <del>[</del>                                       | <del></del>                                      | 2        | 7          | т          | f  | ╀╴           | <del>-</del>                                       | ┲  | <del></del>                                  | 172               |  | 0.0                       |
| 40                       | 25.4            | Ц.,,         | ᆫ  | kν             | 290                 | 276  | <u>t</u>   | <u> </u>   | Ε.       | 7          | 4          | r  | <u>t</u>     | <u>r .</u>   | <u> </u>                                     |  | 172               | ŗ  | P.0                       |
| Mire<br>OS035            | has             | 0            | TYP  | 68             | <b>D3</b>           | 11   | L  | L  | Ια       | 1          | τ          | τ  | E            | L  | τ  | τ  | 22                | Ε'   | 0.0                       |
| J.5035                   | 2               | f            | <del>'</del> ''                              | 20             | 228                 | 76   | <del>1</del>                                       | t  | di.      | •          | t          | f  | t            | t  | ť  | t  | 152               | t  | 0.9                       |
| 104                      |                 | 0            | 770  |                |                     | 51   | <del>[                                    </del>   | <del>[                                    </del> | 5        | F          | f          | f  | ₽            | <del>[                                    </del>   | ₽  | £  | 30                | $\vdash$   | 0.0                       |
| 104                      | 0.03<br>2       | ۳            | TYP  | 65<br>20       | 56<br>205           | <del>•                                      </del> | <del></del>  | <del>[</del>                                     | ľ        | f          | f          | f  | f            | $\overline{}$                                      | f  | ſ  | 207               | <del>[                                    </del> | 0,3                       |
| 1-7                      | ۲               | 1            | <u>1                                    </u> | Κ <sub>0</sub> | 385                 | 352  | <u></u>  |  | ۲        | L          | Ţ          | Ţ. | <u>r</u> _   | Г  | <u>.                                    </u> | <u> </u>                                     | Fu,               | Γ  | Γ'.υ                      |
| <del>रेवर्व</del><br>102 | .0625           | 0            | SMI  | 16P            | 36                  | 30   | τ  | τ  | Б        | Т          | Ţ          | τ  | Ţ            | I.   | Ţ  | Į.   | Į.                | <u> </u>   | 0.0                       |
| 102                      | 1.6             | ť            | 2/4/1  | 20             | 260                 | 205  | <del>!                                      </del> | t  | Ŀ        | t          | t          | t  | t            | <del>[                                    </del>   | t  | 1  | 1                 |  | 0.0                       |
| 104                      | 0.25            | 45           | ΤΫ́Р   | 68             | 53                  | 49   | <del>ľ –</del>                                     | <del>[                                    </del> | _        | 54         | ł          | ŧ  | ╁            | Ł  | t  | t  | 29                | <del>L —</del>                                   | 0.0                       |
| 104                      | 3.35            | 7,2          | ייז ו  | -              | 365                 | 338  | <del></del>  | <del></del>                                      | 1,0      | -          | •          | f  | f            | <del>[</del>                                       | f  | f -  | 200               | <del>[</del>                                     | 0.0                       |
|                          | P.J3            | 1            | Щ.   | 20             | 1203                | ည္မ  | <u>r</u>   | Г  | Ľ        | 1.         | 1          | Γ. | Γ            | <u>r                                     </u>      | <u>r</u>                                     | <u> </u>                                     | 1200              |  | נייט                      |
| Vire<br>i02              | 0.62            | c            | ŤΥΡ  |                | 51                  | <b>I</b> 41  | т  | τ -  | T-       | Ļ          | _          |    | <del></del>  |  | _  | · · · ·                                      | 27                | т  | 0.0                       |

http://www.copper.org/resources/properties/db/CDAP ropertiesResultServlet.jsp?action=search

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|       | 2     |   | <u> </u> | 20 | 352 | 283 | ŀ | Ŀ.       | <b>6</b> F | HH   | ŀ        | ŀ | ŀ | 186 | ┡ | 0.0 |
|-------|-------|---|----------|----|-----|-----|---|----------|------------|------|----------|---|---|-----|---|-----|
| Tube_ |       |   |          |    |     |     |   |          |            |      |          |   |   |     |   |     |
| OS050 | 0.065 | 0 | TΥΡ      | 68 | 32  | 10  | F |          | 40         | - 10 | E        | - | ŀ | 22  | - | 0.0 |
|       | 1.65  |   |          | 20 | 221 | 89  | - | <u>-</u> | 40-        | 40   | <u> </u> | - | Ŀ | 152 |   | 0.0 |

<sup>\*</sup>Fatigue Strength: 100 x 10 <sup>6</sup>cycles, unless indicated as [N]X 10<sup>6</sup>.

**Physical Properties** 

|                                  | US Customary                             | Metric                                   |
|----------------------------------|--|--|
| Melting Point - Liquidus         | 1976 F                                   | 1080 C                                   |
| Melting Point - Solidus          | 1924 F                                   | 1051 C                                   |
| Density                          | 0.323 lb/in <sup>3</sup> at 68 F         | 8.94 gm/cm <sup>3</sup> @ 20 C           |
| Specific Gravity                 | 8.94                                     | 8.94                                     |
| Electrical Resistivity           | 11.2 ohms-cmil/ft @ 68 F                 | 1.86 microhm-cm @ 20 C                   |
| Electrical Conductivity          | 93 %IACS @ 68 F                          | 0.544 MegaSiemens/cm @ 20 C              |
| Thermal Conductivity             | 205.0 Btu · ft/(hr · ft2.ºF)at 68f       | 354.8 W/m · °K at 20 C                   |
| Coefficient of Thermal Expansion | 19.5 ·10 <sup>-6</sup> per ⁰F (68-212 F) | 17.1 -10 <sup>-6</sup> per °C (20-100 C) |
| Coefficient of Thermal Expansion | 9.7 ·10 <sup>-6</sup> per °F (68-392 F)  | 17.5 ·10 <sup>-8</sup> per °C (20-200 C) |
| Coefficient of Thermal Expansion | 19.9 ·10 <sup>-6</sup> per ⁰F (68-572 F) | 17.8 ·10 <sup>-6</sup> per °C (20-300 C) |
| Specific Heat Capacity           | 0.092 Btu/lb/ºF at 68 F                  | 393.5 J/kg · ºK at 293 K                 |
| Modulas of Elasticity in Tension | 17000 ksi                                | 117000 MPa                               |
| Modulus of Rigidity              | 6400 ksi                                 | 44130 MPa                                |

## **Tempers Most Commonly Used**

Flat Products BAR, DRAWNH02

| Other |                  | <del>".</del>           |   |
|-------|------------------|-------------------------|---|
| ROD   | H00, H01, H02, H | 104, OS015, OS035, OS05 | 0 |
| TUBE  | H55, H58, O60    | ·                       |   |
| WIRE  | H00, H01, H02, H | 104, OS035              |   |

# **Typical Uses**

Architecture

Fire Protection

**Electrical** 

Transistor Bases, Electrical Connectors, Motor Parts, Switch Parts, Soldering Copper

Industrial

Furnace Brazed Articles, Soldering Tips, Welding Torch Tips, Screw Machine Products, Forgings

**Plumbing** 

Plumbing Fittings, Sprinkler Heads, Fixtures

Start Another Search

## DISCLAIMER:

The values listed above represent reasonable approximations suitable for general engineering use. Due to commercial variations in compositions and to manufacturing limitations, they should not be used for

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printed 06/01/2011 11:04AM by Luttie.Boarman p. 74/361 Copper.org: Resources: Standards & Properties - Properties of Wrought and Cast Copper Alloys ... Page 4 of 4 specification purposes. See applicable ASTM International specification references.

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# Copper.os

# **Search Results**

C14510 (Tellurium-Bearing)

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|          | ,         | Pb  |         | Te   |
|----------|-----------|-----|---------|------|
| Min/Max. | 99.85 min | .05 | .010030 | .307 |
| Nominal  | 99.50     | -   | 020     | .50  |

- (1) Cu value includes Ag.
- (2) Includes Te +P.

## **Applicable Specifications**

| Product | Specification |
|---------|---------------|
| Bar     | ASTM B301     |
| Rod     | ASTM B301     |
| Shapes  | ASTM B301     |
| Wire    | ASTM B301     |

### **Common Fabrication Processes**

Cold - Drawing, machining, moderate cold heading, Hot - Extrusion, forging (closed die only)

**Fabrication Properties** 

| raprication Properties         |                 |
|--------------------------------|-----------------|
| Joining Technique              | Suitability     |
| Soldering                      | Excellent       |
| Brazing                        | Good            |
| Oxyacetylene Welding           | Fair            |
| Gas Shielded Arc Welding       | Fair            |
| Coated Metal Arc Welding       | Not Recommended |
| Spot Weld                      | Not Recommended |
| Seam Weld                      | Not Recommended |
| Butt Weld                      | Fair            |
| Capacity for Being Cold Worked | Good            |
| Capacity for Being Hot Formed  |                 |
| Forgeability Rating            | 65              |
| Machinability Rating           | 85              |

|               | Section  |          |        |          |            | Sured at<br>Yield<br>Strength<br>(0.6% ext.<br>ender load) | Yield<br>Strength<br>(0.2% |          | EΙ           | Ri<br>Hi | oc<br>ar |          |              | Vickens     | Bri:<br>Har | neli<br>d. | Shear<br>Strength | Fatigee<br>Strength | izod<br>Impact<br>Strengti |
|---------------|----------|----------|--------|----------|------------|--|----------------------------|----------|--------------|----------|----------|----------|--------------|-------------|-------------|------------|-------------------|---------------------|----------------------------|
|               | n,       | ₩        |        | F        | ksi        | ksi  | ksi                        | ksi      | <b>}</b> :   | Þ        | ķ        | ¥F       | 307          | 500         | 200         | 3000       | ksi               | ksi                 | it-ib                      |
|               | mm.      |          |        | c        | MPa        | MPa  | MPs                        | MPa      | Г            | T        | t        | T        |              |             | T           |            | MPa               | MPa                 | J                          |
| Rod           |          |          |        |          |            |  |                            | •        |              | •        | _        | -        |              | -           | •           |            | <u> </u>          |                     |                            |
| H02           | 2        | 15       | TΥP    | S8       | 42         | 39   | -                          | E        | 30           | 42       | Ŧ        | F.,      | F.,          | -           | ŀ           | ŀ          | 25                | F                   | 0.0                        |
|               | 51       |          |        | 20       | 290        | 269  | -                          |          | 35           | 42       | Ţ        | F        | -            | -           | F           | F          | 172               |                     | 0.0                        |
| OS015         | 0.5      | 0        | TYP    | 88       | 33         | 11   |                            |          | 46           | ļ.       | ţ.       | 43       | 1            |             | ┢           | <b>—</b>   | 22                |                     | 0.0                        |
|               | 12.7     |          |        | 20       | 228        | 78   |                            |          | 46           | •        | t        | 43       | _            | -           | F           |            | 152               | -                   | 0.0                        |
| 100           | 0.5      | 6        | TYP    | 58       | 38         | 30   |                            |          | 26           |          | t        | t        | 44           |             | ┢           | ┢          | 25                |                     | 0.0                        |
|               | 12.7     |          |        | 20       | 262        | 207  |                            | _        | _            | J.       | ۰        | t        | 44           |             | ┖           |            | 172               |                     | 0.0                        |
| Wire          |          |          |        |          |            | F  |                            |          |              |          | 1        | <u> </u> | Ι''          |             | <u> </u>    | <u> </u>   | ,,,_              |                     | 7.0                        |
| HOO           | 0.68     | b i      | TYP    | 60       | 38         | 30   | L                          |          | 20           | Ţ.       | F        | F        | F            | Į.          | L           |            | 25                |                     | 0.0                        |
|               | 2        |          |        | 20       | 262        | 207  |                            |          | 20           | -        | t        | F        | F            |             | L           |            | 172               |                     | 0.0                        |
| Rod           |          |          |        |          |            |  |                            |          |              | _        | _        | _        | _            |             |             |            |                   |                     |                            |
| H04           | 0.5      | 35       | TYP    | 66       | 48         | 44   |                            |          | 15           | 48       | ŀ        | F        | F            | F           | F           |            | 27                | -                   | 0.0                        |
|               | 12.7     |          |        | 20       | 331        | 303  |                            |          | 15           | •        | •        | r        | F            |             |             |            | 186               |                     | 0.0                        |
| H02           | 0.25     | 20       | TYP    | 55       | 43         | 40   |                            | _        |              | 43       | 4        | t        | ┢            |             | L           |            | 28                |                     | 0.0                        |
|               | 6.35     |          |        | 20       | 298        | 276  |                            |          | _            | Æ:       | -        | t        | F            |             |             |            | 179               |                     | 0.0                        |
| OS050         | 1        | Ô        | ΥÝΡ    | 66       | 32         | 10   | -                          |          | 50           | 1        | 1        | 40       | <del>_</del> | <u> </u>    | Ł           |            | 22                |                     | 0.0                        |
|               | 25.4     |          |        | 20       | 221        | 69   |                            |          | 50           | -        | t        | 40       | _            |             | Ħ           | _          | 152               |                     | 0.0                        |
| H04           | 1        | 35       | ΤΥΡ    |          | 48         | 44   |                            |          | _            | 48       | F        |          | ₽            |             | F           | <u> </u>   | 27                |                     | 0.0                        |
| ,,,,,         | 25.4     | <u> </u> | ,      | 20       | 331        | 303  |                            |          |              | -        | ٠        | +-       | -            | F           | ╌           |            | 18 <del>6</del>   |                     | -:-                        |
| H02           | 0.5      | 20       | TYP    |          | 43         | 40   |                            |          | J            | 46       | _        | -        | <u> </u>     | Ī           | Ι.          |            |                   |                     | 0.0                        |
| 102           | 12.7     | <u> </u> | , , ,  |          | 296        |  |                            |          | _            | 43       | ٠        | ŀ        | 50           |             | H           | _          | 28                |                     | 0.0                        |
|               | 12.1     |          |        | 20       | X ALC      | 276  |                            |          | 20           | 43       | Ľ,       | L        | 50           |             | <u> </u>    |            | 179               |                     | 0.0                        |
| Tube<br>H55   | 0.065    | 15       | TYP    | RO       | 40         | <b>32</b> (  |                            |          | 20           | 35       | T        | _        | _            |             | _           |            | ha l              |                     | h.,                        |
| 1100          | 1.65     | ,,,      |        | 20       | 276        | 221  |                            | _        | _            | •        | F        | F        | H            |             | ┝           | <b>—</b>   | 24                |                     | 0.0                        |
| D-4           | 1.03     |          | 1      | zu       | KI.O       | 221  |                            |          | 20           | 3:       | Ĺ        | <u>I</u> | _            | <u> </u>    | <u> </u>    | *          | 165               |                     | 0.0                        |
| Rod<br>H02    | 1        | 20       | TYP    |          | 42         | 40   |                            |          | 26           | 42       | ı        | _        |              |             |             |            | - I               | , ;                 | 10.0                       |
| 102           | 25.4     | -        | , ,,   | 20       | 290        | 276  | _                          | -        |              |          | F        | F        | <del>-</del> |             | ┡           | -          | 25                |                     | 0.0                        |
| Wire          | 23.4     |          | L      | κυ       | 290        | 216  | <u> </u>                   | <u> </u> | 25           | 12       | Ł        | <u> </u> | <u> </u>     | <u>t</u>    | Ł           | Ш          | 172               |                     | 0.0                        |
| OS035         | 0.08     | О        | ΤΥP    | 68       | 33         | 11   |                            |          | 40           | _        | т        | _        | _            | ·           |             |            | 22                | i                   | 0.0                        |
| 00000         | 2        | ۳-       | 7 7 1  | 20       | 228        | 76   | <u> </u>                   |          | 40           | F        | F        | F        | H            |             | ┡           | -          | _                 | -                   | 0.0                        |
| H04           | 0.08     | 0        | TYP    |          | 56         | 51   |                            |          | $\mathbf{-}$ | Ĺ        | ۲        | Ľ        | Ľ            |             | L           | _          | 152               | -                   | 0,0                        |
| 104           |          | _        | 117    | 20       | 386        |  |                            | -        | 3            | -        | ŧ        | ┡        | <b>!</b> -   |             | Ι           |            | 30                |                     | 0.0                        |
| Died.         | 2        | Щ        | لــا   | 20       | Nap        | 352  | •                          | ·        | 3            | Ļ        | Ŀ        | L        | <u> </u>     | <u> </u>    | ш           | لــــا     | 207               |                     | 0.0                        |
| Rod<br>H04    | 0.25     | 45       | TYP    | ka       | 53         | 49   |                            |          | - ~          | 54       | 1        |          | _            |             |             | ,          | ng.               |                     | 3.0                        |
|               | 6.35     | • -      |        | 20       | 365        | 338  |                            |          | I            | 2        | F        | ┡        | <del></del>  | <del></del> | Н           |            | 29                |                     | 0.0                        |
| Mileo         | تن       | ـــا     | لــــا | ۲۷       | <i>200</i> | 030  |                            |          | łO           | Ρ4       | Ŀ        | Ľ.       | <u> </u>     | <u> </u>    | Ľ           | لبا        | 200               |                     | 0.0                        |
| Wire<br>H02   | 90.0     | 0        | TYP    | ć c      | 51         | 41   |                            |          | 6            | _        | _        |          | _            |             | _           | _          | 49                |                     | <u> </u>                   |
|               | 2        | Н        |        | 20       | 352        | 283  |                            |          | 6            | F        | F        | F        |              | <del></del> | H           | -          | 27                | -                   | 0.0                        |
| Turb -        | <u> </u> |          |        | ۳۷       | აა∠        | ∠სპ  |                            |          | 2            | L        | Ĺ        | L        |              | r .         | Щ.          |            | 186               | -                   | 0.0                        |
| Tube<br>OS050 | 0.066    | G        | TYP    | en       | 22         | 40   |                            | ,        |              | -        | ÷        | 46       | _            |             | _           | _          | 00                | 1                   |                            |
| U-040U        | 4.65     |          | 117    | 5B<br>2G | 32         | 10   |                            |          | 40           |          |          | 40       |              |             | ŀ           | -          | 22                | -                   | 0.0                        |

<sup>\*</sup>Fatigue Strength: 100 x 10  $^6$ cycles, unless indicated as [N]X 10 $^6$ .

**Physical Properties** 

|                          | US Customary                       | Metric                         |  |  |
|--------------------------|------------------------------------|--------------------------------|--|--|
| Melting Point - Liquidus | 1967 F                             | 1075 C                         |  |  |
| Melting Point - Solidus  | 1924 F                             | 1051 C                         |  |  |
| Density                  | 0.323 lb/in <sup>3</sup> at 68 F   | 8.94 gm/cm <sup>3</sup> @ 20 C |  |  |
| Specific Gravity         | 8.94                               | 8.94                           |  |  |
| Thermal Conductivity     | 205.0 Btu · ft/(hr · ft2.ºF)at 68F | 354.8 W/m · °K at 20 C         |  |  |
|                          |                                    | 1                              |  |  |

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| Coefficient of Thermal Expansion | 9.5 · 10 <sup>-6</sup> per °F (68-212 F) _ | 17.1 ·10 <sup>-6</sup> per <sup>o</sup> C (20-100 C) |
|----------------------------------|--|--|
| Coefficient of Thermal Expansion | 9.7 ·10 <sup>-8</sup> per °F (68-392 F)    | 17.5 ·10 <sup>-8</sup> per °C (20-200 C)             |
| Coefficient of Thermal Expansion | 9.9 ·10 <sup>-8</sup> per °F (68-572 F)    | 17.8 ·10 <sup>-6</sup> per °C (20-300 C)             |
| Specific Heat Capacity           | 0.092 Btu/lb/ºF at 68 F                    | 393.5 J/kg · °K at 293 K                             |
| Modulas of Elasticity in Tension | 17000 ksi                                  | 117000 MPa   |
| Modulus of Rigidity              | 6400 ksi                                   | 44130 MPa  |

# **Tempers Most Commonly Used**

Flat Products BAR, DRAWNH02

| Other |      |      |      | •    |        |        |       |
|-------|------|------|------|------|--------|--------|-------|
| ROD   | H00, | H01, | H02, | H04, | OS015, | OS035, | OS050 |
| TÜBE  | Ĥ55, | H58, | O60  |      |        |        |       |
| WIRE  | H00, | H01, | H02, | H04, | OS035  |        |       |

### Typical Uses

**Architecture** 

Fire Protection

Electrical

Soldering Copper, Transistor Bases, Switch Parts, Motor Parts, Electrical Connectors

Furnace Brazed Articles, Welding Torch Tips, Forgings, Screw Machine Products

Plumbing

Plumbing Fittings, Sprinkler Heads

Start Another Search

#### **DISCLAIMER:**

The values listed above represent reasonable approximations suitable for general engineering use. Due to commercial variations in compositions and to manufacturing limitations, they should not be used for specification purposes. See applicable ASTM International specification references.

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# Copperas

工程 美国美国共和国联系 美洲 机冷吸液压塞剂 链球 机砂板纸 医静脉脉冲 非特殊

## **Search Results**

C19400

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           | Cu       | Fe      | Рb  | P      | Zn    |
|-----------|----------|---------|-----|--------|-------|
| Min./Max. | 97.0 min | 2.1-2.6 | .03 | .01515 | .0520 |
| Nominal   | 97.4     | 2.4     | -   | 04     | .13   |

**Applicable Specifications** 

| Product      | Specification         |
|--------------|-----------------------|
| Bar, Rolled  | ASTM B465             |
| Plate        | ASTM B465             |
| Sheet        | ASTM B465, B694       |
| Strip        | ASTM B465, B888, B694 |
| Tube, Welded | ASME SB543            |
| <u> </u>     | ASTM B543             |

#### **Common Fabrication Processes**

Blanking, Coining, Coppersmithing, Drawing, Etching, Forming and Bending, Heading and Upsetting, Hot Forging and Pressing, Piercing and Punching, Roll Threading and Knurling, Shearing, Spinning, Squeezing and Swaging, Stamping

**Fabrication Properties** 

| Joining Technique              | Suitability     |
|--------------------------------|-----------------|
| Soldering                      | Excellent       |
| Brazing                        | Excellent       |
| Oxyacetylene Welding           | Good            |
| Gas Shielded Arc Welding       | Excellent       |
| Coated Metal Arc Welding       | Not Recommended |
| Spot Weld                      | Not Recommended |
| Seam Weld                      | Not Recommended |
| Butt Weld                      | Good            |
| Capacity for Being Cold Worked | Excellent       |
| Capacity for Being Hot Formed  | Excellent       |
| Forgeability Rating            | 65              |
| Machinability Rating           | 20              |

| n.   n.   mm.      | <b>`</b> | Cold<br>Work | Typ⊻<br>Mān | Temp     | Tensile<br>S <del>tre</del> ngth | Yfeld<br>Strength<br>(0.6% ext.<br>under load) | Yield<br>Strength<br>(0.2%<br>offset) | Yield<br>Strength<br>(0.05%<br>offset) | ĔΙ     | Ro<br>Ha | ck<br>rd | we<br>nes | il<br>•  | Vickens<br>Hard. | Brti<br>Har |           | Shear<br>Strength | Fatigu <del>s</del><br>Strength* | tzod<br>Impact<br>Strengti |
|--|----------|--------------|-------------|----------|----------------------------------|--|---------------------------------------|--|--------|----------|----------|-----------|----------|------------------|-------------|-----------|-------------------|----------------------------------|----------------------------|
| mm.   Flat Products   H14  | ┪        | 36           |             | ļ.,      | ksi                              | kei  | ksi                                   | ksi                                    | ×      |          | d        | FBı       | न        | 500              | 500         | 3000      | kai               | kai                              | it-lib                     |
| Fiat Products H14   0.04   1 Tube WM02   0.035   0.89 C60   0.035   0.89 Fiat Products H08   0.04   1 Tube WM06   0.035   0.89 Fiat Products H04   0.04   1 H05   0.04   1 H06   0.04   1 C50   0.025   0.64 C60   0.025   0.64 Tube U050   0.035   0.89 Fiat Products H14   0.04   1 Tube H80   0.035   0.89 Fiat Products H14   0.04   1 Tube H80   0.035   0.89 WM10   0.035  | ┪        |              | -           | c        | MPa                              | MPs  | MPa                                   | MPa                                    | Ë      | Н        | H        | +         |          |                  | H           | F         | MPa               | MPa                              | ,                          |
| H14 0.04 H12 0.04 H12 0.04 H12 0.04 H12 0.035 0.89 C60 0.035 0.89 C60 0.035 Flat Products H06 0.04 H07 0.04 H07 0.04 H08 0.04 H09 0.04 H09 0.04 H09 0.04 H09 0.05 H09 |          |              | L           | ٢        | 411 4                            | Mr B   | m, -                                  | ole &                                  |        | Ш        | Ц        | Т.        | J        |                  | L .         | L         | nvir a            | NAL EL                           | <u> </u>                   |
| H02  |          | 0            | MIN         | 68       | Į,                               |  | 73                                    |  | -      |          | Ţ        | - 7.      | 3        |                  | _           | <u> </u>  |                   |                                  | 0.0                        |
| 1   Tube   | 寸        |              |             | 20       |                                  |  | 503                                   |  | F      | Ħ        | H        | 7         |          |                  | ┢           |           |                   |                                  | 0.0                        |
| WM02 0.035 0.89 0.89 Flat Products H08 0.04 1 Tube WM08 0.035 0.89 WM04 0.035 0.89 Flat Products H04 0.04 1 0.04 1 0.00 0.025 0.64 0.00 0.025 0.64 0.00 0.035 0.89 H02 0.035 0.89 Flat Products H14 0.04 1 Tube UM08 0.035 0.89 Flat Products H14 0.04 1 Tube UM08 0.035 0.89 Flat Products H14 0.04 1 Tube UM08 0.035 0.89 H09 0.035  | _        | 0            | ΤΥP         |          | 60                               | 50   | 53                                    |  | 9      | 38       | H        | - 30      | -        |                  | ┝           | ┝         |                   |                                  | 00                         |
| WM02 0.035 0.89 0.89 Flat Products H08 0.04 1 Tube WM08 0.035 0.89 WM04 0.035 0.89 Flat Products H04 0.04 1 0.04 1 0.00 0.025 0.64 0.00 0.025 0.64 0.00 0.035 0.89 H02 0.035 0.89 Flat Products H14 0.04 1 Tube UM08 0.035 0.89 Flat Products H14 0.04 1 Tube UM08 0.035 0.89 Flat Products H14 0.04 1 Tube UM08 0.035 0.89 H09 0.035  | T        |              |             | 20       | 414                              | 345  | 385                                   |  | _      | _        | -        | 8         | _        |                  | Γ           | į.        |                   |                                  | 0.0                        |
| WM02 0.035 0.89 C60 0.035 Flat Products H06 0.035 0.89 Flat Products 0.89 Flat Products H04 0.035 0.89 Flat Products H04 0.04 1 C50 0.025 0.64 C60 0.025 0.64 Tube U7ube |          |              | _           |          |                                  | •  |                                       |  |        |          | ш        | _         |          |                  | _           |           |                   |                                  |                            |
| O80 0.035  D89  Flat Producta H08 0.04  1  Tube WM06 0.035  D89  WM04 0.035  D89  Flat Producta H04 0.04  1  C50 0.025  C64  Tube O50 0.035  H02 0.035  H02 0.035  H14 0.04  1  Tube H90 0.035  D89  WM110 0.035   | 5        | 6            | TYP         | 88       | 58                               | -  | 53                                    | ŀ                                      | G.     | 61       |          | ß         | 5        |                  | F           | F         | -                 | ŀ                                | 0.0                        |
| 0.89 Flat Products H06 0.04 1 Tube WM06 0.035 0.89 WM04 0.035 0.89 Flat Products H04 0.04 1 C50 0.025 0.64 Tube 050 0.035 0.89 H02 0.035 H02 0.035 H14 0.04 1 Tube H00 0.035 U.89 H14 0.04 1 Tube H80 0.035 0.89 WM10 0.035  |          |              |             | 20       | 4G0                              | -  | 365                                   |  | 9      | 61       | П        | -         | 2        |                  | Ļ           | -         |                   | -                                | 0.0                        |
| Fist Products H06 0.04 1 Tube WM06 0.035 0.89 WM04 0.035 0.89 Fist Products H04 0.04 1 C050 0.025 0.64 C060 0.025 0.64 Tube 0.035 0.89 Fist Products H14 0.04 1 Tube H90 0.035 0.89 WM10 0.035   | 5        | 0            | ΤΥP         | 68       | 45                               |  | 24                                    | ·                                      |        | 33       | Ħ        | †         |          | -                | Г           | -         |                   | -                                | 0.0                        |
| H06 0.04  Tube  WM06 0.035  0.89  WM04 0.035  0.89  Flat Products  H04 0.04  1  C50 0.025  0.64  Tube  050 0.035  0.89  Flat Products  H04 0.035  0.89  H02 0.035  0.89  Flat Products  H14 0.04  1  Tube  H90 0.035  0.89  WM10 0.035   |          |              |             | 20       | 310                              | -  | 165                                   | _                                      | 28     | 3£       | П        | Ţ         |          | -                | -           | F         | -                 | -                                | 0.0                        |
| 1 Tube  WM96 0.035  0.89  WM04 0.035  0.89  Flat Products H04 0.04  1 0.04  1 0.050 0.025 0.64  Tube  050 0.035 0.89  Flat Products H14 0.04  1 Tube H90 0.035 0.89  WM10 0.035  | 3        |              |             |          |                                  | ·  |                                       |  |        |          | _        |           | _        |                  | L           | L         |                   | L                                | <u></u>                    |
| WM06 0.035  0.89  WM04 0.035  0.89  Flat Products H04 0.04  1 H06 0.04  1 C50 0.025 0.64  C60 0.035 0.89  H02 0.035 H02 0.035 H14 0.04 1 Tube H00 0.035 0.89  WM10 0.035   |          | O.           | TYP         | 68       | 70                               | -  | 68                                    |  | 3      | 74       | E        | - 7       | 1        | -                | Ŀ           | F         | -                 | -                                | 0.0                        |
| WMD6 0.035  0.89  WM04 0.035  0.89  Flat Products H04 0.04  1  H05 0.04  0.64  0.64  0.64  0.64  0.050 0.035  0.89  Flat Products H14 0.04  1  Tube H90 0.035 0.89  WM10 0.035   | I        |              |             | 20       | 183                              | -  | 465                                   | F                                      | 3      | 74       | ŀ        | - 7       | ,        | ,                | -           | -         |                   | ŀ                                | 0.0                        |
| 0.89 WM04 0.035 Plat Products H04 0.04 1 H05 0.025 0.64 C060 0.025 0.64 Tube C050 0.035 0.89 Flat Products H14 0.04 1 Tube H00 0.035 0.89 WM10 0.035   |          |              |             |          |                                  |  |                                       |  |        |          | _        |           |          |                  |             |           |                   |                                  | P-1                        |
| MM04 0.035  Plat Products H04 0.04 1 H06 0.025 0.64 C060 0.025 0.64 Tube C050 0.035 0.89 Flat Products H14 0.04 1 Tube H80 0.035 0.89 WM10 0.035   | 5        | 0            | TYP         | _        | 70                               |  | δB                                    | •                                      | _      | 74       | Ц        | - lô      | 1        | -                | Ŀ           | <u> </u>  | -                 | -                                | 0.0                        |
| 0.89   Flat Products     H04   | +        |              |             | 20       | 483                              | -  | 465                                   |  | 3      | 74       | Ł        | 6         | ٠.       | 1                | Ш           |           | ·                 |                                  | 0.0                        |
| Flat Products H04 0.04 1 H05 0.04 1 C050 0.025 0.64 C060 0.035 0.89 H02 0.035 0.89 Flat Products H14 0.04 1 Tube H00 0.035 0.89 WM10 0.035   | 5        | 0            | ΤYΡ         | 68       | B5                               |  | 63                                    |  | 4      | 73       | Ц        | - 64      | 3        |                  | Ĺ           | Ŀ         |                   |                                  | 0.0                        |
| H04 0.04 H05 0.04 H06 0.025 0.64 C050 0.025 0.64 Tube C050 0.035 0.89 Flet Products H14 0.04 1 Tube H00 0.035 0.89 WM10 0.035  | 1        |              |             | 20       | 448                              | <u> </u>                                       | 434                                   | ·                                      | 4      | 73       | Ł        | - 81      | 3        |                  |             | •         | -                 | ,                                | 0.0                        |
| 1 H06 0.04 1 C50 0.025 0.64 C80 0.025 0.64 Tube C50 0.035 0.89 H02 0.035 0.89 Flat Products H14 0.04 1 Tube H80 0.035 0.89   | _        | ,            | _           |          | ·                                |  | ,                                     |  |        |          | _        | _         | _        |                  |             |           |                   |                                  |                            |
| 1 050 0.025 0.64 0.64 0.035 0.89 0.035 0.89 0.035 0.89 0.035 0.89 0.035 0.89 0.035 0.89 0.035 0.89 0.035   | _        | 6            | TΥP         |          | 67                               | <u> </u>                                       | 63                                    | <u> </u>                               | 4      |          | _        | Þ         | -        |                  | Ŀ           | ┝         | -                 | 21                               | 0.0                        |
| 1 050 0.025 0.64 0.64 0.035 0.035 0.89 0.035 0.89 0.035 0.89 0.035 0.89 0.035 0.89 0.035 0.89 0.035 0.89 0.035 0.89 0.035  | _        |              | <u> </u>    | 20       | 462                              | <u> </u>                                       | 434                                   | ,                                      | *      | 73       |          | _         |          |                  | _           | <u> </u>  | -                 | 145                              | 0.0                        |
| 0.64 O60 0.025 0.64 Tube O50 0.035 0.89 H02 0.635 0.89 Flat Products H14 0.04 1 Tube H80 0.035 0.89 WM10 0.035   | _        | 9            | ΤΫ́Р        |          | 73                               | <u> </u>                                       | 71                                    | ·                                      | ₹.     | 75       | н        | - 7.      | -        |                  | _           | <b>-</b>  |                   | 22                               | 0.0                        |
| 0.64 O60 0.025 0.64 Tube O50 0.035 0.89 H02 0.635 0.89 Flat Products H14 0.04 1 Tube H80 0.035 0.89 WM10 0.035   |          |              | <u> </u>    | 20       | 503                              |  | 486                                   | -                                      | Ł      | 75       |          | 7.        | 2        |                  | _           | ш         | -                 | 148                              | 0.0                        |
| O60 0.025 0.64 Tube O50 0.035 0.89 H02 0.035 0.89 Flat Products H14 0.04 1 Tube H80 0.035 0.89 WM10 0.035  | _        | 0            | ΤΥP         | •        | 50                               | <u> </u>                                       | 30                                    | <u> </u>                               | 22     | Ĝ        | _        | ŧ         | 4        |                  | <u> </u>    | ┡         | <u></u>           | -                                | 0.0                        |
| 0.64 Tube O50 0.035 0.89 H02 0.635 0.89 Flat Products H14 0.04 1 Tube H80 0.035 0.89 WM10 0.035  |          |              |             | 20       | 345                              | -  | 207                                   | •                                      | 29     | 45       | Ł        | ·ŀ        |          |                  | ٠.          | Ł.        | t.                | ·                                | 0.0                        |
| Tube  O50 0.035 0.89  H02 0.035 0.89  Flet Products H14 0.04 1  Tube H80 0.035 0.89  WM10 0.035  | 5        |              | TYP         |          | 45                               | ŀ  | 24                                    |  | 32     | 38       | Ц        | Ł         |          |                  | L           | Ŀ         |                   | 16                               | 0.0                        |
| 0.035<br>0.89<br>H02 0.035<br>0.89<br>Flat Products<br>H14 0.04<br>1<br>Tube<br>H80 0.035<br>0.89<br>WM10 0.035  | 1        |              |             | 20       | 310                              | -  | 185                                   | ·                                      | 32     | 38       | ŀ        | ŀ         |          | -                | Ł           |           |                   | 110                              | 0.0                        |
| 0.89 H02 0.635 0.89 Flat Products H14 0.04 1 Tubs H80 0.035 0.89 WM10 0.035  | _        |              |             |          |                                  | -  |                                       |  | _      |          | _        | _         | _        |                  |             |           |                   |                                  |                            |
| H02 0.035<br>0.89<br>Flat Products<br>H14 0.04<br>1<br>Tube<br>H80 0.035<br>0.89<br>WM10 0.035   | _        | 0            | ΥP          |          | 50                               | -  | 30                                    |  | _      | 45       |          | ╪         | 4        |                  | ⊨           | ļ         |                   |                                  | 0.0                        |
| 0.89 Flat Products H14 0.04 1 Tube H80 0.035 0.89 WM10 0.035   |          |              |             | 20       | 345                              | <u> </u>                                       | 207                                   | <u> </u>                               |        | 45       |          | _         |          |                  | <u> </u>    | <u> </u>  |                   |                                  | 0.0                        |
| Flet Products H14 0.04 1 Tube H80 0.035 0.89 WM10 0.035  | ${}$     |              | TYP         | _        | 58                               | <u> </u>                                       | 55                                    | <u> </u>                               |        | 5        | Ц        | 8         |          | -                | ▙           | ┝         |                   |                                  | 0.0                        |
| H14 0.04<br>1<br>Tube<br>H80 0.035<br>0.89   | _        | <u> </u>     |             | 20       | 400                              | -  | 379                                   | <u> </u>                               | 9      | 61       | Ł        | Ĝ         | ן נ      | -                | -           |           |                   |                                  | 0.0                        |
| 1<br>Tube<br>H80 0.035<br>0.89<br>VVM10 0.035  |          |              |             |          | τ                                |  |                                       |  | _      | -        |          | _         |          |                  |             |           |                   |                                  |                            |
| H90 0.035<br>0.89<br>WM10 0.035  | -        | c            | TYP         | _        | 80                               | -  | <u> </u>                              | <del></del>                            | 1      | H        | H        | ŧ         | 4        |                  | H           | ┡         | •                 | -                                | 0.0                        |
| H90 0.035<br>0.89<br>WM10 0.035  |          |              | Ц_          | 20       | 552                              | <u>t.                                    </u>  | <u> </u>                              | -                                      | 1      | L        | H        | <u>†</u>  |          | -                | <u> </u>    | <u> </u>  | •                 |                                  | 0.0                        |
| 0.89<br>WM10 0.035   | E        | 35           | TYP         | e c      | 89                               | 1  | 66                                    |  | 5      |          | т        | h.        |          |                  | _           | _         |                   |                                  | 0.0                        |
| WM10 0.035   | _        | 30           | 1 7 6       | 20<br>20 | 469                              | <del></del>                                    | 96<br>455                             |  | _      |          | _        | 6         |          |                  | H           | H         | -                 | •                                | 0.0                        |
|  |          |              | 77/0        |          |                                  | <del></del>                                    |                                       |  | _      |          |          | 5         |          | 1                | _           |           |                   |                                  |                            |
|  | _        | 0            | TYP         | _        | 76                               |  | 73<br>500                             |  | 1      |          | 7        | . 3:      |          | _                | H           | H         |                   | •                                | 0.0                        |
|  | _        | 0            | T-77        | 20       | 524                              |  | 503                                   | <del></del>                            | 1      | 7E       |          | Ĝ:        |          |                  | Ï           | H         |                   | •                                | 0.0                        |
| VAA08 0.035  | _        | `            | ŢΥΡ         |          | 73                               |  | 71                                    |  | ત્યી ( | _        | H        | 5         | _        |                  | -           |           |                   |                                  | 0.0                        |
| 0,89   |          | Щ.           | Ц.          | 20       | 503                              | <u> </u>                                       | 486                                   |  | 2      | 75       | Ц        | ĥ         | <u>'</u> | <u> </u>         | <u> </u>    | ــــــــا | t                 |                                  | 0.0                        |
| Flat Products H10 0.04   |          |              | TYP         | gg       | 76                               | L  | 73                                    | <del></del>                            | 7      | 77       | П        | 7.        | ,        |                  |             | ,         | _                 | <b>2</b> 1                       | 0.0                        |
| 1 10 0.04  |          | o i          |             |          |                                  | _  | mr J                                  | ~                                      |        |          |          |           |          | _                | r           | r         | _                 | K.I                              | μ.υ                        |

<sup>\*</sup>Fatigue Strength: 100 x 10  $^{6}$ cycles, unless indicated as [N]X 10 $^{8}$ .

**Physical Properties** 

|                          | US Customary | Metric |  |
|--------------------------|--------------|--------|--|
| Melting Point - Liquidus | 1990 F       | 1088 C |  |
| Melting Point - Solidus  | 1980 F       | 1082 C |  |

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| Density                          | 0.322 lb/in <sup>3</sup> at 68 F        | 8.91 gm/cm <sup>3</sup> @ 20 C           |
|----------------------------------|---|--|
| Specific Gravity                 | 8.91                                    | 8.91                                     |
| Electrical Resistivity           | 15.0 ohms-cmil/ft @ 68 F                | 2.49 microhm-cm @ 20 C                   |
| Electrical Conductivity          | 65 %IACS @ 68 F                         | 0.38 MegaSiemens/cm @ 20 C               |
| Thermal Conductivity             | 150.0 Btu · ft/(hr · ft2-°F)at 68f      | 259.6 W/m - °K at 20 C                   |
| Coefficient of Thermal Expansion | 9.8 ·10 <sup>-6</sup> per °F (68-572 F) | 17.6 ·10 <sup>-6</sup> per °C (20-300 C) |
| Specific Heat Capacity           | 0.092 Btu/lb/ºF at 68 F                 | 385.5 J/kg ⋅ ºK at 293 K                 |
| Modulas of Elasticity in Tension | 17500 ksi                               | 121000 MPa                               |
| Modulus of Rigidity              | 6600 ksi                                | 45510 MPa                                |

**Tempers Most Commonly Used** 

| Flat Products |          |       |        |      |      |      |       |
|---------------|----------|-------|--------|------|------|------|-------|
| STRIP, ROLLED | H02. H04 | . H06 | , H08, | H10, | O50, | O50, | OTHER |

| Other    |            |             | **        |          |
|----------|------------|-------------|-----------|----------|
| TUBE H02 | , H04, H06 | , H08, H10, | H55, H80, | O50, O60 |

### Typical Uses

Automotive

Electrical Connectors - Automotive, Fuel Injectors

Consumer

Gift Hollow Ware

Electrical

Lead Frames, Electrical Connectors, Cable Wrap, Clamps, Plug Contacts, Fuse Clips, Terminals, Circuit Breaker Components, Contact Springs, Electrical Springs

**Fasteners** 

Rivets

Industrial

Eyelets, Welded Condenser Tubes, Gaskets, Flexible Metal Hose

Start Another Search

#### DISCLAIMER:

The values listed above represent reasonable approximations suitable for general engineering use. Due to commercial variations in compositions and to manufacturing limitations, they should not be used for specification purposes. See applicable ASTM International specification references.

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# Copperom

# **Search Results**

C21000 (Gilding, 95%)

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           | Cu<br>Cu  | Fe | Pb | Zπ   |
|-----------|-----------|----|----|------|
| Min./Max. | 94.0-96.0 | 05 | 05 | Rem. |
| Nominal   | 95.0      |    |    | 5.0  |

Note: Cu + Sum of Named Elements, 99.8% min.

**Applicable Specifications** 

| Product      | Specification              |
|--------------|----------------------------|
| Bar          | ASTM B36<br>SAE J463, J461 |
| Plate        | ASTM B36                   |
| Sheet        | ASTM B36<br>SAE J463, J461 |
| Strip        | ASTM B36<br>SAE J463, J461 |
| Tube, Welded | ASTM B587                  |
| Wire         | ASTM B134                  |

### **Common Fabrication Processes**

Blanking, Coining, Drawing, Etching, Forming and Bending, Piercing and Punching, Shearing, Spinning, Squeezing and Swaging, Stamping

**Fabrication Properties** 

| Joining Technique            | Suitability     |
|------------------------------|-----------------|
| Soldering                    | Excellent       |
| Brazing                      | Excellent       |
| Oxyacetylene Welding         | Good            |
| Gas Shielded Arc Welding     | Good            |
| Coated Metal Arc Welding     | Not Recommended |
| Spot Weld                    | Not Recommended |
| Seam Weld                    | Not Recommended |
| Butt Weld                    | Good            |
| Capacity for Being Cold Work | ed Excellent    |

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| Capacity for Being Hot Formed | Good |
|-------------------------------|------|
| Machinability Rating          | 20   |

| Temper   | Section<br>Size | Cold<br>Work | Typ/<br>Min | Temp | Tensile<br>Strength | Yield<br>Strength<br>(0.5% ext.<br>under load) |     | Ylekd<br>Strength<br>(0,65%<br>offset) | EI | Ri X | DC<br>arc | kwi<br>ine | eli<br>55 | Vickens<br>Hard. | 8ri<br>Hai |      | Shear<br>Strength | Fatigue<br>Strength | izod<br>Impact<br>Strengt |
|----------|-----------------|--------------|-------------|------|---------------------|--|-----|--|----|------|-----------|------------|-----------|------------------|------------|------|-------------------|---------------------|---------------------------|
|          | in.             | **           |             | F    | ksi                 | ksi  | ksi | ksi                                    | Ж  | В    | ¢         | F          | 301       | 500              | 500        | 3000 | ksi               | ksi                 | R⊣b                       |
|          | mm,             |              |             | Ç    | мРа                 | мра  | MPa | MPa                                    |    |      | I         |            |           |                  |            |      | MPs               | MPa                 | J                         |
| Flat Pro | ducts           |              |             |      |                     |  |     |  |    |      |           | _          | _         |                  | •          |      |                   |                     |                           |
| OS015    | 0.04            | o ¯          | TYP         | 68   | 38                  | 14   | -   |  | 42 | F    | E         | 60         | 15        | -                | -          | -    | 30                | Ë                   | 0.0                       |
|          | 1               |              | [           | 20   | 262                 | 97   | -   | -                                      | 42 | ŀ    | F         | 60         | 15        | -                | -          | F    | 207               | -                   | 0.0                       |
| H02      | 0.04            | O            | TYP         | 68   | 48                  | 40   | -   | -                                      | 12 | 52   | E         | Е          | 54        | -                |            | -    | 34                |                     | 0.0                       |
|          | 1               |              |             | 20   | 331                 | 276  | -   | -                                      | 12 | 52   | Ŧ         | Г          | 54        | ļ.,              | F          | F    | 234               | -                   | 0.0                       |
| O\$035   | 0.04            | 0            | ΤΥP         | 68   | 35                  | 11   | E   |  | 45 | F.   | Ė         | 52         | 4         |                  | -          | F    | 2 <b>a</b>        | -                   | 0.0                       |
|          | 1               |              |             | 20   | 241                 | 78   | F   | •                                      | 45 | F    | F         | 52         | 4         | ļ .              | F          | -    | 193               | -                   | 0.0                       |
| H06      | 0.04            | 0            | TYP         | 68   | 81                  | 55   |     |  | *  | 70   | ŧ         | Г          | 54        |                  |            | -    | 39                |                     | 0.0                       |
|          | 1               |              |             | 20   | 421                 | 379  | -   | -                                      | 4  | 70   | Ŧ         | F          | 64        | ļ.               | F          | -    | 269               | -                   | 0.0                       |
| H04      | 0.04            | 0            | ΤYΡ         | 68   | 56                  | 50   | F   |  | 5  | 64   | F         | E          | 60        | -                | F          | F    | 37                |                     | 0,0                       |
|          | 1               |              | ł           | 20   | 386                 | 345  | ļ - |  | 5  | 64   | Į         | ŀ          | 60        |                  |            | -    | 255               | _                   | 0.0                       |
| BÖH      | 0.04            | C            | TYP         | 68   | 64                  | 58   | E   |  | ;  | 72   | Ė         | E          | 66        |                  |            |      | 40                |                     | 0.0                       |
|          | 1               |              |             | 20   | 441                 | 400  | F   | -                                      | 4  | 73   | F         | F          | 66        | -                | Γ          | F    | 276               | -                   | 0.0                       |
| Q8050    | 0.04            | 0            | TYP         | 66   | 34                  | 10   | F   | -                                      | 45 | Ŀ    | ŧ         | 46         | -         | -                |            | F    |                   |                     | 0.0                       |
|          | 1               |              |             | 20   | 234                 | 69   | -   |  | 45 | F    | F         | 46         |           | -                | F          | F    | -                 | -                   | 0.0                       |
| UA4      | N A 4           | h            | 77/25       | P-0  | 40                  | 22   | 1   |  | L. | ۱.,  | +         | t          | -         |                  | _          | 1    | 20                | 1                   |                           |

<sup>\*</sup>Fatigue Strength: 100 x 10 <sup>6</sup>cycles, unless indicated as [N]X 10<sup>6</sup>.

**Physical Properties** 

|                                  | US Customary                             | Metric   |
|----------------------------------|--|--|
| Melting Point - Liquidus         | 1950 F                                   | 1066 C   |
| Melting Point - Solidus          | 1920 F                                   | 1049 C   |
| Density                          | 0.32 lb/in <sup>3</sup> at 68 F          | 8.86 gm/cm <sup>3</sup> @ 20 C                       |
| Specific Gravity                 | 8.86                                     | 8.86   |
| Electrical Resistivity           | 18.5 ohms-cmil/ft @ 68 F                 | 3.08 microhm-cm @ 20 C                               |
| Electrical Conductivity          | 56 %IACS @ 68 F                          | 0.328 MegaSiemens/cm @ 20 C                          |
| Thermal Conductivity             | 135.0 Btu · ft/(hr · ft2-°F)at 68F       | 233.6 W/m ⋅ °K at 20 C                               |
| Coefficient of Thermal Expansion | 10.0 ·10 <sup>-8</sup> per °F (68-572 F) | 18.0 ·10 <sup>-6</sup> per <sup>a</sup> C (20-300 C) |
| Specific Heat Capacity           | 0.09 Btu/lb/ºF at 68 F                   | 377.1 J/kg - °K at 293 K                             |
| Modulas of Elasticity in Tension | 17000 ksi                                | 117000 MPa   |
| Modulus of Rigidity              | 6400 ksi                                 | 44130 MPa  |

**Tempers Most Commonly Used** 

Flat Products STRIP, ROLLED H01, H02, H04, H06, H08, OS015, OS035, OS050

Other TUBEH55, H58, H80, O50, O60, OS035 WRE OS015, OS025, OS035, OS050

Typical Uses

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Architecture

Ornamental Trim

Consumer

Jewelry, Plaques, Medallions, Emblems

**Electrical** 

Rotor Bars, AC Motors, Connectors

**Fasteners** 

Fasteners

Industrial

Base for Vitreous Enamel, Base for Gold Plate

Fuse Caps, Firing Pin Support Shells, Bullet Jackets, Primers, Small Arm Ammunition: Primer Caps, Bullet Jackets

Other

Medals, Coins, Tokens

Start Another Search

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# Copperac

其地 此一篇化转音声电影 納馬馬利爾馬利地 唇毛外肌 相望 表外语 音音和

## Search Results

C22000 (Commercial Bronze, 90%)

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           | Cu        | e   | Pb  | Zn   |
|-----------|-----------|-----|-----|------|
| Min./Max. | 89.0-91.0 | .05 | .05 | Rem. |
| Nominal   | 90.0      | ,   |     | 10.0 |

Note: Cu + Sum of Named Elements, 99.8% min.

**Applicable Specifications** 

| Product                    | Specification                          |
|----------------------------|--|
| Bands, Projectile Rotating | MILITARY MIL-B-20292, MIL-B-18907      |
| Bar                        | ASTM B36<br>SAE J461, J463             |
| Cups, Bullet Jacket        | ASTM B131<br>MILITARY MIL-C-3383       |
| Plate                      | ASTM B36                               |
| Sheet                      | ASTM B36, B694<br>SAE J463, J461       |
| Strip                      | ASTM B694, B36, B130<br>SAE J461, J463 |
| Tube                       | ASTM B135<br>SAE J461, J463            |
| Tube, Rectangular Waveguid | e ASTM B372<br>MILITARY MIL-W-85       |
| Tube, Welded               | ASTM B587                              |
| Wire                       | ASTM B134                              |
| Wire, Metallizing          | MILITARY MIL-W-6712                    |

## **Common Fabrication Processes**

Blanking, Coining, Drawing, Etching, Forming and Bending, Heading and Upsetting, Hot Forging and Pressing, Piercing and Punching, Roll Threading and Knurling, Shearing, Spinning, Squeezing and Swaging, Stamping

| Fabrication Properties |
|------------------------|
|------------------------|

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| Joining Technique              | Suitability     |
|--------------------------------|-----------------|
| Soldering                      | Excellent       |
| Brazing                        | Excellent       |
| Oxyacetylene Welding           | Good            |
| Gas Shielded Arc Welding       | Good            |
| Coated Metal Arc Welding       | Not Recommended |
| Spot Weld                      | Not Recommended |
| Seam Weld                      | Not Recommended |
| Butt Weld                      | Good            |
| Capacity for Being Cold Worked |                 |
| Capacity for Being Hot Formed  | Good            |
| Machinability Rating           | 20              |

| Temper        |          |              |          | Temp     | 1         | Yield<br>Strength<br>(0,6% ext.<br>under load) | Yield<br>Strength<br>10.2% | Yield    |            |        |          |          |     |          |          | rell<br>d. | Shear<br>Strength | Fatigue<br>Strength                            | izod<br>impact<br>Strengti |
|---------------|----------|--------------|----------|----------|-----------|--|----------------------------|----------|------------|--------|----------|----------|-----|----------|----------|------------|-------------------|--|----------------------------|
|               | n.       | ¥₁           |          | ᄕ        | ksi       | ksi  | ksi                        | ksi      | Ŕ          | В      | þ        | =        | 301 | 500      | 500      | 3000       | kal               | kal  | lt-Ib                      |
|               | mm       |              |          | υ        | MРa       | MPa  | MPa                        | MPa      |            |        | П        |          |     |          |          |            | MPa               | MPu  | J                          |
| Wire          |          |              |          |          |           |  |                            |          |            |        |          |          |     |          |          |            |                   |  |                            |
| H06           | 0.08     | ٥            | Ϋ́Р      |          | 83        | <u> </u>                                       | <u> </u>                   | <u> </u> | 2          | Ŀ      | H        | _        | _   | <u> </u> | Ŀ        | <u>-</u>   | <u> </u>          | <u> </u>                                       | 0.0                        |
|               | 2        | L            |          | 2D       | 572       | <u> </u>                                       | <u> </u>                   | <u> </u> | 3          | Ŀ      | ŀŀ       |          | -   | <u> </u> | -        | -          | <u> </u>          | •  | 0.0                        |
| Tube          |          |              |          |          | G E       |  |                            |          | _          |        |          | ٠,       |     |          |          | _          |                   |  |                            |
| H80           | 0.0      | 35           | ŢΥP      |          | 60        | 53   |                            | -        | 5          | 66     | H        | _        | 62  |          | Ŀ        | <u> </u>   | <u> </u>          |  | 0.0                        |
|               | 0.0      |              |          | 20       | 414       | 385  | <u> </u>                   | <u> </u> | 6          | 39     | <u>t</u> |          | €2  | t        | <u> </u> | <u> </u>   | <u> </u>          | <u> </u>                                       | 0.0                        |
| Flat Pro      |          | -            | EVE I    |          | 10.7      | Ca.  |                            |          | 40         | _      | Α.       | 1        |     |          |          | _          |                   |  | h.a.                       |
| M20           | 0.25     | P            | TYP      |          | 37        | 10   | <del></del>                | -        | 45         | i-     | H        |          |     |          | H        | <u> </u>   | <u> </u>          | -  | 0,0                        |
|               | 8.35     |              | <u> </u> | 20       | 255       | 69   | <u> </u>                   | <u> </u> | 45         | Ľ.     | 4        |          | 28  |          | Ŀ        | <u> </u>   | <u> </u>          |  | 0.0                        |
| H02           | 0.25     | <u> </u>     | TYP      |          | 52        | 45   | -                          |          | _          | 56     | _        | 4        | •   | <u> </u> | F        | <b>├</b>   | 35                | •  | 0.0                        |
| 22547         | 6.35     |              |          | 20       | 359       | 310  |                            |          |            | 88     |          |          |     |          | <u> </u> | <u> </u>   | 241               |  | Ċ.O                        |
| OS015         | 0.04     | 0            | ΤΥP      |          | 41        | 15   | -                          | _        | 42         | Ŀ      | H        | -1       |     | -        | ┡        | ┝          | 32                | <b></b>  | 0.0                        |
|               | 1        |              |          | 20       | 283       | 103  | <u> </u>                   |          | <b>4</b> Z | _      | _        | 4        |     |          | <u> </u> | <u> </u>   | 221               |  | 0.0                        |
| H02           | 0.04     | 0            | ΤΥΡ      |          | 52        | 45   | <u> </u>                   | _        | 11         | -      | H        | -        | 56  |          | Ŀ        | ┝          | 35                | <u>-                                      </u> | 0.0                        |
|               | 1        |              |          | 20       | 359       | 310  |                            |          | 11         | 58     | ŁŁ       |          | 56  |          | Ш        |            | 241               | -  | 0.0                        |
| Rod           |          |              | C        | B        |           | <del>-</del>                                   |                            |          |            |        |          | _        |     |          | _        |            |                   |  |                            |
| H00           | 0.5      | -            | ΤΥP      | _        | 45        | <u> </u>                                       |                            | •        |            | 42     | H        | 4        | •   | •        | H        | Ĺ          | 33                | -  | 0.0                        |
|               | 12,7     | ļ.,          |          | 20       | 310       | <u> </u>                                       |                            |          | 25         | 42     | ĿĿ       | _        | -   |          | L        | <u> </u>   | 228               | <u> </u>                                       | 0,0                        |
| Wire<br>H01   | 80.0     | _            | -VR      | e n      | leo.      |  |                            |          |            |        | _        | _        | _   |          | _        |            | h                 | 1  | 0.0                        |
| וטח           | 2        | -            | TYP      | 20<br>20 | 50<br>345 |  | -                          |          | 13         | Н      | H        | +        | -   | _        | H        | _          | 34                |  | 0.0                        |
| H00           | 0.08     | <u> </u>     |          |          |           |  | -                          |          | 13         | L      | Н        | 4        | _   |          | $\perp$  |            | 234               |  | 0.0                        |
| HUV           | _        | -            | ŢΥΡ      |          | 44        | <u> </u>                                       | -                          |          | 2          | H      | H        | 4        |     |          | H        |            | 33                |  | 0.0                        |
|               | 2        |              |          | 20       | 303       | <u> </u>                                       | <u> </u>                   |          | 27         |        | Ħ        | _        | •   |          |          | _          | 228               |  | 0.0                        |
| Flat Pro      |          | o            | TYP      | 60       | 38        | 12   |                            | _        | 50         | П      | Т.       | 7        |     |          | _        | _          | 30                |  | 0.0                        |
| 0000          | 8.35     |              |          | 20       | 262       | 83   |                            | -        | ЫS         | H      |          | 7        | _   |          |          |            |                   |  | 0.0                        |
| OS035         | 0.04     |              | ΤΥΡ      |          | 38        | 12   |                            |          | 50<br>45   | Н      | Н        | _        |     | _        | Ц        |            | 207<br>30         |  | 0.0                        |
| 03033         | 0.04     | ۳            | 111      | 20<br>20 | 262       | 83   |                            |          | _          | H      | -        | -        |     |          | H        | H          |                   |  |                            |
| uoc           | 2 2 4    |              | TUD      |          |           |  | _                          |          | <b>4</b> 5 | Н      |          | 4        | _   |          | Ц        |            | 207               |  | 0.0                        |
| H06           | 0.04     | H            | TYP      |          | 67        | 58   |                            |          | 4          | 75<br> | H        | -1       | 67  |          | H        | H          | 40                |  | 0.0                        |
| - N.          | 1        | ليسا         |          | 20       | 462       | 400  | <u> </u>                   | <u> </u> | 4          | 75     |          |          | 57  |          | <u> </u> | <u> </u>   | 278               | <u> </u>                                       | 0.0                        |
| Tube<br>OS035 | 0.0      | 0            | TYP      | co       | 38        | 12   |                            |          | 50         |        | - 1:     | <b>ਜ</b> | 40  | _        |          |            |                   |  | 0.0                        |
| 23033         | 0.0      | <del>-</del> |          | _        | 262       | 93   |                            |          | 50         | H      |          | #        | _   |          |          | -          |                   |  | 0.0                        |
| Flat Pro      |          |              | Ь        | 217      | 202       | 0.5  | Ţ                          |          | JU         | Ļ      |          | "        | 12  | Ĺ        |          |            | اا                |  | 0.0                        |
|               |          | 0            | ТҮР      | 68       | 31        | 54   |                            |          | 5          | 70     | F        | 7        | 33  |          |          |            | 38                |  | 0.0                        |
|               | 1        |              | .,       |          | 421       | 372  |                            |          | 5          | 70     | Ħ        | -        | 53  |          | Н        | H          | 262               |  | 0.0                        |
| Wire          | •        |              |          | 2.5      | -21       | 212  |                            |          | •          | , 0    | П        | ľ        | ~   |          | Ε        |            | 202               | Ī  | 0.0                        |
| OSO15         | 0.08     | ο            | TYP      | 68       | 42        |  | [. ]                       | <u> </u> | 46         |        | . [      | 7        |     | . 1      |          |            | 32                |  | 0.0                        |
|               | 2        |              | I        |          | 290       |  |                            |          | 40         | H      | H        | f        |     |          | -        |            | 221               |  | 0.0                        |
| _             | <u> </u> | لـــا        | L        | ۳        | K SV      |  | <u> </u>                   |          | +6         |        | L        | _        |     |          | L        | Ш          | CZ 1              |  | ν,υ                        |

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| H08      | 0.04   | 0   | ΥP  | 68 | 72  | 62       |             | Ŀ        | 3    | 78         | - J-  | <b>69</b>    | -        | -   | ŀ        | 42  | 21   | 0.0 |
|----------|--------|-----|-----|----|-----|----------|-------------|----------|------|------------|-------|--------------|----------|-----|----------|-----|------|-----|
|          | 1      |     |     | 20 | 496 | 427      | -           | -        | 3    | 78         |       | 69           |          | L   | F        | 290 | 145  | C,O |
| Wire     |        |     |     |    |     |          |             |          |      |            |       | _            | <u> </u> |     | •        |     |      |     |
| H02      | 80.0   | þ.  | TYP | 68 | 90  | -        | F           |          | 3    | E          | Œ     | ŀ            | ļ.,      | F   | <u> </u> | -   | ŢF T | 0.0 |
|          | 2      |     | 1   | 20 | 621 | -        | 1           | 1        | 3    | H          | - [-  | ŀ            | }-       | 7   | F        | -   | -    | 0.0 |
| Rod      |        |     |     |    |     |          |             |          |      |            |       | •            |          |     |          |     |      |     |
| 05035    | 0.5    | D_  | TYP | 85 | 40  | Ŀ        | F           | Œ        | 50   | Ð          | - 5:  | E            | 1        | F   | E        | 32  | E    | 0.0 |
|          | 12.7   | 1   | 1   | 20 | 276 | }        | ŀ           | ŀ        | 50   | $\Gamma$   | - 50  | ¥_           | I        | - F | F        | 221 | -    | 0.0 |
| Flat Pro | oducts |     |     | •  |     |          |             |          | _    |            |       |              |          |     |          |     |      |     |
| M20      | 0.04   | ) i | TYP | 88 | 39  | 14       |             |          | 44   | П          | - 60  | ì            | -        | Ŀ   | E        | 31  | F    | 0,0 |
|          | 1      | 1   | 1   | 20 | 269 | 97       | ŀ           | -        | - 44 | $\vdash$   | - 61  | <del>}</del> |          | 1   | F -      | 214 | -    | 0.0 |
| Wire     | -      |     |     |    |     |          |             |          |      |            |       |              |          |     | -        | •   |      | _   |
| H04      | 80.0   | 0   | TYP | бā | 74  | <u> </u> | ŀ           | <u>.</u> | 4    | Ŀ          | Œ     | ŀ            | -        | E.  | ŀ_       | 42  | 23   | 0.0 |
| -        | þ      | 1   | H   | 20 | 510 | -        | ŀ           | - F      | -    | <b>F F</b> | ŀ     | F            | -        | +   | ļ-       | 296 | 159  | 0.0 |
| OS035    | 60.0   | 0   | TYP | 68 | 40  | 1        | <u> </u>    |          | 50   |            | Ŧ     | Ē            | F        | Ī   | Ē        | 30  | 1    | 0.0 |
|          | 2      |     | 1   | 50 | 276 | -        | <b>—</b>    | 7        | 50   | F          | · F   | F            |          | _   | -        | 207 | -    | 0.0 |
| Flat Pro | oducts |     |     |    |     |          | <del></del> |          |      |            |       |              |          |     | •        |     |      |     |
| 08050    | 0.04   | 0   | TYP | 68 | 37  | 10       | _ F         | ŀ        | 45   | F          | - 53  | de e         | 1        | 1   | ŀ        | 28  | F    | 0.0 |
|          | 1      |     |     | 20 | 255 | 59       |             | 1        | 45   | F          | . jo: | <b>)</b> 6   | ļ .      | Ţ   | F        | 193 |      | 0.0 |
| Wire     |        |     |     |    |     |          |             |          |      |            |       | _            |          |     |          |     |      |     |
| H02      | 0.08   | b_  | TYP | 68 | 60  | ŀ        |             | <u> </u> | Ĝ    | E          | F     | ŀ            | F        | F   | F        | 37  | }-   | 0.0 |
|          | 2      |     |     | 20 | 414 | -        | T           | -        | 6    | H          |       | L            | -        | ┰   | F        | 255 | 1    | 0.0 |
| Flat Pro | oducta |     |     |    |     |          |             |          |      | _          | _     | _            |          |     |          |     |      |     |
| OS025    | C.04   | þ   | TYP | 68 | 38  | 14       | -           | F        | 44   | ΕĴ         | - B(  | 16           | <u> </u> | E   | F        | 31  | ļ    | 0.0 |
|          | 1      |     |     | 20 | 269 | 97       | -           |          | 14   | FT         | - 30  | 16           | 1        | F   | F        | 214 | F    | 0.0 |
| H01      | 0.04   | 0   | TYP | 68 | 45  | 35       | F           | 1        | 25   | 42         | - -   | 44           |          | ŀ   | F        | 33  | +    | 0.0 |
|          | 1      |     | Т   | 20 | 310 | 241      |             |          | 25   | 1,2        | T     | 44           | L '      | T   | τ        | 228 |      | 0,0 |

<sup>\*</sup>Fatigue Strength: 100 x 10  $^{6}$ cycles, unless indicated as [N]X 10 $^{6}$ .

**Physical Properties** 

|                                  | US Customary                             | Metric                                   |
|----------------------------------|--|--|
| Melting Point - Liquidus         | 1910 F                                   | 1043 C                                   |
| Melting Point - Solidus          | 1870 F                                   | 1021 C                                   |
| Density                          | 0.318 lb/in <sup>3</sup> at 68 F         | 8.8 gm/cm <sup>3</sup> @ 20 C            |
| Specific Gravity                 | 8.8                                      | 8.8                                      |
| Electrical Resistivity           | 23.6 ohms-cmil/ft @ 68 F                 | 3.92 microhm-cm @ 20 C                   |
| Electrical Conductivity          | 44 %IACS @ 68 F                          | 0.257 MegaSiemens/cm @ 20 C              |
| Thermal Conductivity             | 109.0 Btu · ft/(hr · ft2·°F)at 68F       | 188.7 W/m · °K at 20 C                   |
| Coefficient of Thermal Expansion | 10.2 ·10 <sup>-6</sup> per °F (68-572 F) | 18.4 ·10 <sup>-6</sup> per °C (20-300 C) |
| Specific Heat Capacity           | 0.09 Btu/lb/ºF at 68 F                   | 377.1 J/kg · ºK at 293 K                 |
| Modulas of Elasticity in Tension | 17000 ksi                                | 117000 MPa                               |
| Modulus of Rigidity              | 6400 ksi                                 | 44130 MPa                                |

**Tempers Most Commonly Used** 

| Flat Products |   |
|---------------|---|
| PLATE         | H02, M20, OS035                                     |
| SHEET         | H02, M20, OS035                                     |
| STRIP, ROLLED | H01, H02, H04, H06, H08, OS015, OS025, OS035, OS050 |

| Other |                                |
|-------|--------------------------------|
| ROD   | H00, OS035                     |
| TUBE  | H55, H58, H80, O50, O60, OS035 |
|       |                                |

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# WREH00, H01, H02, H04, H06, H08, OS015, OS035

Typical Uses

**Architecture** 

Ornamental Trim, Weather Stripping, Etching Bronze, Screen Cloth, Grill Work

**Builders Hardware** 

Hardware, Kick Plates

Consumer

Chain Links, Lipstick Cases, Housing for Lipstick Compacts, Costume Jewelry, Ball Point Pens, Compacts,

Caskets

**Electrical** 

Cable Wrap, Wave Guides, Rotor Bar - AC Motors

**Fasteners** 

Rivets, Line Clamps, Bolts, Screws, Screw Shells

Industrial

Flexible Tube, Screen Wire, Escutcheons, Base for Vitreous Enamel, Studs

Marine

Marine Hardware

Ordnance

Primer Caps, Rotating Bands, Small Arms Cartridges, Artillery Projectile Rotating Bands, Press Fit

Plumbers Brass Goods

Start Another Search

#### DISCLAIMER:

The values listed above represent reasonable approximations suitable for general engineering use. Due to commercial variations in compositions and to manufacturing limitations, they should not be used for specification purposes. See applicable ASTM International specification references.

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# Copperm

拉索 6570000 姓 主动的CB <u>宇宙</u> 和加速<u>空气活动</u> 600 点面局部 9星的 自由标题 诗野动脉

## Search Results

C23000 (Red Brass, 85%)

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           | Cu        | Fe  | Pb  | Zn · |
|-----------|-----------|-----|-----|------|
| Min./Max. | 84.0-86.0 | .05 | .05 | Rem. |
| Nominal   | 85.0      |     | ,   | 15.0 |

Note: Cu + Sum of Named Elements, 99.8% min.

Applicable Specifications

| Product         | Specification   |
|-----------------|---|
| Bar             | ASTM B36  |
| Fittings        | ASME B16.29, B16.22   |
| Nipples         | ASTM B687   |
| Pipe            | ASME SB43<br>ASTM B698, B43   |
| Plate           | ASTM B36  |
| Sheet           | ASTM B36<br>SAE J461, J463  |
| Strip           | ASTM B888, B36<br>SAE J463, J461  |
| Tube            | ASTM B569, B698   |
| Tube, Condenser | ASME SB111<br>ASTM B111   |
| Tube, Finned    | ASME SB359<br>ASTM B359   |
| Tube, Seamless  | AMS 4553<br>ASME SB135<br>ASTM B135<br>FEDERAL WW-T-791<br>MILITARY MIL-T-20168<br>SAE J461, J463 |
| Tube, U-Bend    | ASME SB395<br>ASTM B395   |
| Tube, Welded    | ASME SB543<br>ASTM B587, B543   |

http://www.copper.org/resources/properties/db/CDAPropertiesResultServlet.jsp?action=search

| Wire | ASTM B134 |  |
|------|-----------|--|
|      |           |  |

#### **Common Fabrication Processes**

Blanking, Coining, Drawing, Etching, Forming and Bending, Heading and Upsetting, Piercing and Punching, Roll Threading and Knurling, Shearing, Spinning, Squeezing and Swaging, Stamping

**Fabrication Properties** 

| Joining Technique              | Suitability     |
|--------------------------------|-----------------|
| Soldering                      | Excellent       |
| Brazing                        | Excellent       |
| Oxyacetylene Welding           | Good            |
| Gas Shielded Arc Welding       | Good            |
| Coated Metal Arc Welding       | Not Recommended |
| Spot Weld                      | Fair            |
| Seam Weld                      | Not Recommended |
| Butt Weld                      | Good            |
| Capacity for Being Cold Worked | Excellent       |
| Capacity for Being Hot Formed  | Good            |
| Machinability Rating           | 30              |

| Mechanical Properties (measured at room temperature, 68 F (20 | C | :) |
|---|---|----|
|---|---|----|

| AICCII  | anica           | <u>i fik</u> | he          | HUCS     | insta    | Suled at                                       |  | rempe                                  | ۲a | L  | <u>ur</u>   | υ,        | 00          | P (ZU           | <u>UJ</u>   |           |                   |  |                           |
|---------|-----------------|--------------|-------------|----------|----------|--|--|--|----|----|-------------|-----------|-------------|-----------------|-------------|-----------|-------------------|--|---------------------------|
| Temper  | Section<br>Stze | Cold<br>Work | Typ.<br>Min | Temp     |          | Yield<br>Strength<br>(0.5% ext.<br>under load) | Strength<br>(0.2%                      | Yield<br>Strength<br>(0.05%<br>offset) | Ei | R  | toc<br>lare | kw<br>Inc | rell<br>938 | Mckens<br>Hard. | Bri:<br>Har | ne‼<br>ಚ. | Shour<br>Strength | Fotigue<br>Strength'                             | tzod<br>Impact<br>Strengt |
|         | ìл.             | %            | L.          | F        | ksi      | ksi  | ksi                                    | kai                                    | %  | B  | c           | F         | 301         | 500             | 500         | 3000      | ksi               | ksi  | H-ID                      |
|         | mm.             |              |             | C        | MPa      | MPa  | мРа                                    | МРа                                    | Γ  | T  | T           | Γ         | Т           |                 |             |           | MPa               | MPa  | J                         |
| lat Pro |                 |              |             |          |          | <u> </u>                                       |  |  |    |    |             | _         |             |                 |             |           |                   |  |                           |
| VI20    | 0.0             | o            | ΤYΡ         | 88       | 42       | -  |  |  | Ŀ  | Ŀ  | ŀ           | Ŀ         | ŀ           |                 | F           | <u> </u>  | -                 |  | 0.0_                      |
|         | 0.0             |              | l           | 20       | 299      | ŀ  | -                                      | -                                      |    | F  | ŀ           | ŀ         | F           | -               | F           | F         | ļ-                | F  | G.O                       |
| OS015   | 0.04            | D .          | TYP         | 68       | 45       | 18   | -                                      |  | 42 | ŀ  | ŀ           | 71        | 38          |                 | -           |           | 33                | -  | 0.0                       |
|         | 1               |              |             | 20       | 310      | 124  | -                                      | _                                      | 42 | F  | Ŧ           | F         | 38          | -               | F           | -         | 228               | -  | 0.0                       |
| 102     | 0.04            | D .          | TYP         | 68       | 57       | 49   | -                                      |  | 12 | 6  | 5           | r         | 80          | 1               |             | -         | 37                |  | 0,0                       |
|         | 1               |              |             | 20       | 393      | 338  | -                                      |  | 12 | 6  | 5.          | F         | 60          | ļ.              |             |           | 255               |  | 0.0                       |
| Wire    | <u> </u>        |              | •           |          | <u> </u> |  |  |  | ٠, | ٠. |             | _         | _           |                 |             | <u> </u>  | L                 | <b></b>  |                           |
| HO0     | 0.08            | O.           | TYP         | 68       | 50       | F  |  | _                                      | 25 | F  | Ŧ.          | Ł         | F           | -               |             | F         | 35                | 20   | 0.0                       |
|         | 2               |              |             | 20       | 345      |  |  |  | 25 | ŀ  | Ţ           | F         | Ī.          | ļ.              | F           | L         | 241               | 138  | 0.0                       |
| 101     | 0.08            | 6            | ΤΥΡ         | 88       | 59       |  | _                                      | _                                      | 11 | t  | t           | F         | F           |                 | _           |           | 38                |  | 0.0                       |
|         | 2               |              |             | 20       | 407      |  |  |  | 11 | F  | Ţ           | Ļ         | Γ           |                 | Г           | -         | 262               |  | 0.0                       |
| lat Pro | ducts           |              |             | ٠        |          |  |  |  | -  | _  | _           | -         | ٠           |                 | <u> </u>    |           |                   | <del></del>                                      | <u> </u>                  |
|         |                 | 0            | TYP         | 38       | 78       | 61   | -                                      |  | 4  | 3  | 3-          | F         | 72          | -               | F           | ŀ         | 44                | F  | 0.0                       |
|         | 1               |              |             | 20       | 538      | 421  |  | -                                      | 4  | 8  | 3           | Į.        | 72          | -               |             | ١,        | 303               |  | 0.0                       |
| OS035   | 0.04            | 8            | ΤΥP         | 68       | 41       | 14   | _                                      |  | 46 | F  | t           | 53        | 22          | -               | F           | $\vdash$  | 31                | -  | 0.0                       |
|         | 1               |              |             | 20       | 283      | 97   | _                                      |  | 48 | Ţ  | Ţ           | 63        | 22          |                 |             |           | 214               |  | 0.0                       |
| oipe    |                 |              | _           | <u> </u> |          |  | لـــــــــــــــــــــــــــــــــــــ | L                                      |    | ۲. | _           | _         | 1           | L .             |             |           |                   |  | F <sup></sup> .           |
| 0\$015  | 0.0             | 0            | TYP         | 68       | 44       | 18   |  | Ċ                                      | 45 | Γ  | F           | 71        | Ι-          | ļ.              |             |           | -                 | F  | 0.0                       |
| _       | 0.0             |              |             | 20       | 303      | 124  |  | _                                      | 45 | ļ  | Ŧ           | 71        | F           |                 | П           |           |                   | -  | 0.0                       |
| ube     |                 |              |             |          |          |  |  |  |    | _  | _           | _         | _           |                 | ш           |           |                   | <del>'                                    </del> |                           |
| 180     | 0 065           | 35           | TΥΡ         | 68       | 70       | 58   | -                                      |  | 8  | 7  | 7           | F         | 68          | F               | F           | -         | - 1               |  | 0.0                       |
|         | 1,65            |              |             | 20       | 483      | 400  |  |  | 8  | 7  | 7-          | _         | 68          |                 | Г           |           | -                 |  | 0.0                       |
| lat Pro | ducts           |              |             |          |          |  |  |  |    | _  | _           |           | _           |                 |             |           |                   |  | ٠                         |
| 104     | 0.04            | 0            | ΤYΡ         | 38       | 70       | 57   |  |  | 5  | 7  | 7 F         | E         | 66          | F               | - 1         | F         | 12                |  | 0.0                       |
|         | 1               |              |             | 20       | 483      | 393  |  |  | 5  | 7. | 7           | Г         | 38          | -               | -           |           | 290               | _  | 0.0                       |
| Vire    |                 |              |             |          |          |  |  |  |    | ۲  |             | _         |             | <u> </u>        | ليسا        |           |                   | ·  | <u> </u>                  |
| )S015   | Ĉ.08            | 0            | TYP         | 68       | 45       |  |  |  | -  | Ē  | E           | E         | E           | £               | E I         | - ]       | 33                |  | 0.0                       |
|         | 2               |              |             | 20       | 310      | -  |  | _                                      |    | Ľ  | F           | Ļ         | F           | -               |             | -         | 228               | -  | 0.0                       |
| lat Pro | ducts           |              |             |          |          |  |  |  |    | -  | 1           | _         | ٠           |                 |             | ш         |                   |  |                           |
|         |                 | 0            | TYP         | 68       | B4       | 63   | - 1                                    | -                                      | 3  | 38 | 1           | F         | 74          | -               |             |           | 46                | _  | 0.0                       |
|         |                 |              |             |          |          |  |  |  | П  |    | П           | _         | _           |                 |             |           |                   |  |                           |

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|          | 1        |                |     | 20       | 579 | 434          | <u>_</u>    | F   | 3    | 36      | -    | þ4         | ŀ           | F  | ł        | 317  | 1  | 0.0      |
|----------|----------|----------------|-----|----------|-----|--------------|-------------|---|------|---------|------|------------|-------------|----|----------|--|--|----------|
| Wire     |          |                |     |          |     |              |             |   |      |         |      |            |             |    |          | -  |  |          |
| HD8      | 80.0     | D              | TYP | 38       | 105 | <u>.</u>     | <u> </u>    |   | E    | . ]     | Ŧ    | F          | F           | F  | Ŀ        | 54   | F  | 0.0      |
|          | 2        | 1              |     | 20       | 724 | -            | ŀ           | -   | FI   | . [     | ·F   | ŀ          | -           | Ţ  | I_       | 372  | $\mathbf{T}$                                       | 0.0      |
| Flat Pro | oducts   |                |     |          |     |              |             |   |      |         | _    |            |             |    |          |  |  |          |
| 05070    | 0.04     | 0              | TYP | 38       | 39  | 10           |             | -   | 48   | П       | . 56 | 10         | F           | F  | F        | 31   | F  | 0.0      |
|          | 1        |                | 1   | 20       | 269 | 69           | -           | -   | 48   | . ]     | 56   | 10         | F           | Ţ  |          | 214  | -  | 0.0      |
| Tube     |          | •              | •   | •        |     |              |             | <del></del>                                       |      | _       | -    | ۰-         |             | ٠. |          | <del>*</del>                                     |  |          |
| H55      | 0.065    | 15             | TYP | 88       | 50  | 40           | T           | J   | 30   | 55      | Т    | 54         | F           | F  | F        | T T  | T  | 0.0      |
|          | 1.65     |                |     | 20       | 345 | 276          | -           | -   | 30   | 55      | F    | 54         | -           | Ţ  | F        |  | Ţ  | 0.0      |
| Wire     |          | _              | ·   |          |     |              | <u> </u>    | <del>'</del>                                      |      | _       |      | 1          | <del></del> |    | <b>1</b> | -  | 1  |          |
| 0\$035   | 0.08     | 0              | TYP | 68       | 41  | Ŧ            | ÷.          | Ī   | 48   | . ]     | F    | E          | F           | F  | F        | 31   | F.   | 0.0      |
|          | 2:       |                |     | 20       | 283 | F            | -           | -   | 48   | 7       | F    | F          | -           | F  | F        | 214  | F  | 0.0      |
| H04      | 0.08     | 0              | TYP | 68       | 38  | Ţ            | -           | <del>                                     </del>  | ы    | 1       | +    | 1          |             | ╁  | ┢        | 48   | +  | 0.0      |
|          | 2        |                |     | 20       | 507 | T            | -           | 1   | â    | . ]     | 1    | Ī          |             | 1. | Ţ        | 331  |  | 0,0      |
| Flat Pro | oducts   |                |     | _        |     |              |             | - F   |      | _       |      | _          | L           | 1  | <u></u>  |  |  |          |
| OS050    |          | 0              | TYP | 68       | 40  | 12           | -           | 1   | 47   | Ţ       | 55   | 14         | F           | ŀ  | į.       | 31   | Ţ.   | 0.0      |
|          | 1        | T              |     | 20       | 276 | 83           |             |   | 47   | 7       | 59   | 14         |             | T  |          | 214  |  | 0.0      |
| Wire     |          |                | _   |          |     |              |             | •   |      | _       | _    | _          |             |    | _        |  |  |          |
| O\$025   | 0.08     | þ              | TYP | 68       | 43  | 1            | -           | ļ   | FI   | T       | T    | F          | F .         | F  | F        | 32   | F  | 0.0      |
|          | 2        | 1              |     | 20       | 296 | Ţ            |             | Ţ   | П    | 7       | T    | F          |             | 1  |          | 221  | Ţ.   | 0.0      |
| H02      | 0.08     | 0              | TYP | 68       | 72  | <del> </del> |             | <del>                                      </del> | 6    | 7       | +    | ┢          | -           | ╁┈ |          | 43   | <del> </del>                                       | 0.0      |
|          | 2        | 1              | 1   | 20       | 496 | -            |             | <del>                                     </del>  | ß    | . 1     | t    | t          |             | †  |          | 298  | <del>.                                      </del> | 0.0      |
| Tube     |          |                |     |          | 1   |              |             |   | ГΙ   |         |      | _          |             | Ц  |          |  | ــــــــــــــــــــــــــــــــــــــ             |          |
|          | 0.065    | 0              | TYP | 68_      | 4D  | 12           | +           | ŀ   | 55   |         | 60   | 15         | F           | Ŧ  | ŀ        | F  | F  | 0.0      |
|          | 1.65     |                | Г   | 20       | 276 | 83           |             | 1   | 55   | -       | -    | 15         | -           | T  | F        | ļ  | 1  | 0.0      |
| OS015    | 0.065    | 0              | ТУР |          | 44  | 18           |             | ⇟   | 44   |         | 71   | _          |             | †- | 一        | <del>                                     </del> | <del></del>  | 0.0      |
| -        | 1.65     | T              | +-  | 20       | 303 | 124          |             | t —   | 45   | -       | +    | na         | <b>.</b>    | t  | t        | t  | t  | 0.0      |
| Flat Pro | <u> </u> | <del>'</del> — |     | <u> </u> |     | <u> </u>     |             |   | 1.~[ | _1      | Т,   |            |             |    | Ь        | <u> —</u>  |  | <u> </u> |
| H01      | 0.0      | ю              | ТУР | 68       | 49  | F            | 1           | ī   | L    | 15      | T    | 48         | F           | Ţ  | L        | L  | Į.   | 0.0      |
|          | 0.0      | 1              | -   | 20       | 338 | 1            | 1           | 1   | -    | ;<br>;5 | -    | 48         | t           | t  | t        | t  | t  | 0.0      |
| OS025    | _        | 6              | ΤΥΡ |          | 43  | 16           | <del></del> | +-  | 44   |         | 68   |            | -           | ₽  | H        | 32   | ┼  | 0.0      |
|          | J.U.     | <u> ''</u>     | 111 | -11      |     | 110          |             |   | . *  |         | 100  | <u>420</u> | <u>r</u>    |    | <u> </u> | <u>ی</u>   | <u>r</u>   | U.V      |

<sup>\*</sup>Fatigue Strength: 100 x 10 <sup>6</sup>cycles, unless indicated as [N]X 10<sup>8</sup>.

**Physical Properties** 

|                                  | US Customary                             | Metric                                    |
|----------------------------------|--|---|
| Melting Point - Liquidus         | 1880 F                                   | 1027 C                                    |
| Melting Point - Solidus          | 1810 F                                   | 988 C                                     |
| Density                          | 0.316 lb/in <sup>3</sup> at <b>68</b> F  | 8.75 gm/cm <sup>3</sup> @ 20 C            |
| Specific Gravity                 | 8.75                                     | 8.75                                      |
| Electrical Resistivity           | 28.0 ohms-cmil/ft @ 68 F                 | 4.65 microhm-cm @ 20 C                    |
| Electrical Conductivity          | 37 %IACS @ 68 F                          | 0.216 MegaSiemens/cm @ 20 C               |
| Thermal Conductivity             | 92.0 Btu · ft/(hr · ft2·°F)at 68F        | 159.2 W/m · °K at 20 C                    |
| Coefficient of Thermal Expansion | 10.4 ·10 <sup>-6</sup> per °F (68-572 F) | 18.7 · 10 <sup>-6</sup> per °C (20-300 C) |
| Specific Heat Capacity           | 0.09 Btu/lb/°F at 68 F                   | 377.1 J/kg · ºK at 293 K                  |
| Modulas of Elasticity in Tension | 17000 ksi                                | 117000 MPa                                |
| Modulus of Rigidity              | 6400 ksi                                 | 44130 MPa                                 |

**Tempers Most Commonly Used** 

| Flat Products |   |
|---------------|---|
| SHEET         | H02, OS050  |
| STRIP, ROLLED | H01, H02, H04, H06, H08, OS015, OS025, OS035, OS050, OS07 |

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| Other |      |      |      |        |          |          |          |
|-------|------|------|------|--------|----------|----------|----------|
| PIPE  | OS01 | 15   |      | _      | _        | _        | =        |
| TUBE  | H55, | H58, | H80, | OS015  | , OS070  |          |          |
| WIRE  | H00. | H01, | H02, | H04, F | 108. OS0 | 15, OS02 | 5, OS035 |

#### **Typical Uses**

Architecture

Etching Parts, Weather Strip, Trim

**Builders Hardware** 

Kick Plates

Consumer

Fire Extinguisher Cases, Tokens, Costume Jewelry, Coinage, Zippers, Badges, Nameplates, Compacts, Medallions, Plaques, Dials, Lipstick Containers, Rouge Boxes

Electrica

Sockets, Screw Shells, Conduit, Rotor Bars, AC Motors

**Fasteners** 

Fasteners, Eyelets

Industrial

Heat Exchanger Shells, Flexible Metal Hose, Pump Cylinder Liners, Tags, Radiator Cores, Pickling Crates, Condenser Tubes, Fire Extinguishers, Tubing for Instrumentation, Tubing for Heat Exchangers, Heat Exchangers

Other

Fire Hose Couplings

Plumbing

Fittings, Pump Lines, Pipe Service Lines, Pipe Nipples, Pipe, Service Lines, J-Bends, Traps

Start Another Search

#### **DISCLAIMER:**

The values listed above represent reasonable approximations suitable for general engineering use. Due to commercial variations in compositions and to manufacturing limitations, they should not be used for specification purposes. See applicable ASTM International specification references.

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# Copperus

# **Search Results**

C24000 (Low Brass, 80%)

Last Updated: Apr 28, 2008

### **Chemical Composition**

(%max., unless shown as range or min.)

|           | Cu<br>Cu  | Fe |     |      |
|-----------|-----------|----|-----|------|
| Min./Max. | 78.5-81.5 | 05 | .05 | Rem. |
| Nominal   | 80.0      | -  | ·   | 20.0 |

Note: Cu + Sum of Named Elements, 99.8% min.

**Applicable Specifications** 

| Product              | Specification              |
|----------------------|----------------------------|
| Ваг                  | ASTM B36                   |
| Brazing Filler Metal | FEDERAL QQ-B-650           |
| Plate                | ASTM B36                   |
| Sheet                | ASTM B36<br>SAE J463, J461 |
| Strip                | ASTM B36<br>SAE J461, J463 |
| Wire                 | ASTM B134                  |

#### **Common Fabrication Processes**

Blanking, Drawing, Etching, Forming and Bending, Heading and Upsetting, Piercing and Punching, Roll Threading and Knurling, Shearing, Spinning, Squeezing and Swaging, Stamping

**Fabrication Properties** 

| Tubilication i Toperties      |                 |
|-------------------------------|-----------------|
| Joining Technique             | Suitability     |
| Soldering                     | Excellent       |
| Brazing                       | Excellent       |
| Oxyacetylene Welding          | Good            |
| Gas Shielded Arc Welding      | Good            |
| Coated Metal Arc Welding      | Not Recommended |
| Spot Weld                     | Fair            |
| Seam Weld                     | Not Recommended |
| Butt Weld                     | Good            |
| Capacity for Being Cold Worke | edExcellent     |
|                               |                 |

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| Capacity for Being Hot Formed | Fair |
|-------------------------------|------|
| Machinability Rating          | 30   |

| Vlech:            | anica           | Pro          | pe                                     | rties    | (mea:               | sured at  |                                       | tempe  | ra       | tυ       | ıre | ₽,       | 68       | F (20            | C)         |  |                   |                                       |                            |
|-------------------|-----------------|--------------|--|----------|---------------------|---|---------------------------------------|--|----------|----------|-----|----------|----------|------------------|------------|--|-------------------|---------------------------------------|----------------------------|
| Temper            | Section<br>Size | Cold<br>Work | Typ/<br>Min                            | Temp     | Tensile<br>Strength | Yleid<br>Strangth<br>(0.5% ext.<br>under load)  | Yield<br>Strength<br>(0,2%<br>offset) | Yleid<br>Strength<br>(0.05%<br>offset)           | ΕI       | Ro       | oc) | ne       | 68<br>88 | Vickens<br>Hard, | Bri<br>Nai |  | Shear<br>Strength | Fatigue<br>Strength                   | tzod<br>Impact<br>Strengti |
|                   | m.              | Ŕ            |  | F        | ksi                 | ksi   | ksi                                   | ksi  | %        | В        | ¢   | Ŀ        | 307      | 5Ç0              | 50C        | 3060   | ksi               | ksi                                   | ft-ib                      |
|                   | mm.             |              |  | U        | MPa                 | MPa   | MPa                                   | MPa  | Γ        |          |     |          |          |                  |            |  | мРа               | MPa                                   | J                          |
| Wite              |                 |              |  |          |                     |   |                                       |  | _        | _        |     |          |          |                  | _          |  |                   |                                       |                            |
| H06               | 0.08            | 0            | qyy                                    |          | 116                 | <del></del>                                     | <u> </u>                              | <u> </u>   | 4_       | Ł        | Ħ   | Ŀ        | ⊨        | <u> </u>         | <u> </u>   | -  | <u> </u>          |                                       | 0,0                        |
|                   | 2               | L.,_         |  | 20       | 800                 | <u> </u>  | <u> </u>                              | t  | 4        | Ł        | Ł   | Ŀ        | Ľ_       | <u> </u>         | <u> </u>   | <u> </u>   | <u> </u>          |                                       | 0.0                        |
| Flat Pro<br>H02   |                 | 0            | TYP                                    | 60       | 61                  | 50  |                                       | 1  | 1 0      | 70       |     | _        | 64       |                  |            |  | 39 ·              |                                       | 0.0                        |
| 1.02              | 1               | ř—           | -                                      | 20       | 421                 | 345   | [                                     |  | •        | 70       | -   | Н        | 7.<br>74 |                  | t          | $\vdash$   | 269               |                                       | 0.0                        |
| OS015             |                 | 0            | ТҮР                                    |          | 50                  | 20  |                                       |  | 46       | _        | Н   | 75       | 12       | <del></del>      | ┢          | <del>[                                    </del> | 33                | $\vdash$                              | 0.0                        |
| 00010             | 1               |              | <u> </u>                               | 20       | 345                 | 138   |                                       |  | 46       |          | t   | _        | 42       |                  | t          |  | 228               | _                                     | 0.0                        |
| VVire             | <u>'</u>        | <u> </u>     | <u> </u>                               |          | P+0                 |   |                                       |  | Γ.       | L        | L   |          | ,,,      | <u> </u>         |            |  |                   |                                       | J                          |
| HOO               | 0.08            | Ω            | TYP                                    | 88       | 56                  | -   | -                                     | ŀ  | 27       | ŀ.       | ŀ   | F        | F        | -                | ļ.         | ŀ  | 37                |                                       | 0.0                        |
|                   | 2               |              |  | 20       | 386                 | -   | F                                     | -  | 27       | F        | F   | Γ        | F        |                  | F          | F  | 255               | -                                     | 0.0                        |
| H01               | 0.08            | 0            | ТҮР                                    | 68       | 68                  | -   | ł                                     |  | 12       | E        | Ŀ   | Ŀ        | E        |                  | Ŀ          | ŀ.   | 42                |                                       | 0.0                        |
|                   | 2               |              |  | 20       | 469                 | <u> </u>  | <u> </u>                              | -  | 12       | F        | F   | F        | E        | E                | F          | F  | <b>5</b> 80       |                                       | 0.0                        |
| Flat Pro          | ducts           |              |  |          |                     |   |                                       |  |          |          |     |          |          |                  |            |  |                   |                                       |                            |
| OS035             | 0.04            | 0            | TŸΡ                                    | 88       | 46                  | 15  |                                       | -  | 48       |          | Ł   |          | 28       | -                | _          | F  | ·                 | · · · · · · · · · · · · · · · · · · · | 0.0                        |
|                   | 1               |              |  | 20       | 317                 | 103   | <u> </u>                              | -  | 48       | Ł        | Ł   | 66       | 28       | <u> </u>         | <u> </u>   | Ł.,  | -                 | -                                     | 0.0                        |
| H04               | 0.04            | 0            | TYP                                    | 68       | 74                  | 59  | F                                     | <u> </u>   | 7        | 82       | •   |          | 71       | <u> </u>         | Ł.         | -  | 43                |                                       | 0.0                        |
|                   | 1               | <u> </u>     |  | 50       | 510                 | 407   | <u> </u>                              | <u> </u>   | 7        | 82       | Ł   | Ė        | 71       | <u> </u>         | <u> </u>   | <u>t</u>   | 296               |                                       | 0.0                        |
| Wire              | h 00            | <u> </u>     | havo                                   | b.,      | le s                | T   | ,                                     |  |          |          |     | _        |          |                  | Υ-         |  | laa               |                                       | h 0                        |
| O\$015            | 0.08            | 0            | TΥΡ                                    |          | 50                  |   | •                                     |  | 47       |          | H   | Ł        | Ë        |                  | ŧ-         | <del>-</del>                                     | 33                |                                       | 0.0                        |
|                   | 2               |              |  | 20       | 345                 |   | <u> </u>                              | <u> </u>   | 47       | ┺        | H   | L        |          |                  | <u> </u>   | <u> </u>   | 228               |                                       | 0.0                        |
| OS050             | 0.08            | 0            | TYP                                    |          | 44                  | <u> </u>  |                                       | <u> </u>   | 55       | _        | H   | H        | H        | -                | ŧ-         | ╄  | 32                | _                                     | 0.0                        |
| <b>-</b> 4 5      | ν               | <u> </u>     |  | 20       | 303                 | <u> </u>  | •                                     | r  | 55       | <u> </u> | Ł   | _        | _        | <u> </u>         | <u> </u>   | <u> </u>   | 221               |                                       | 0.0                        |
| Flat Pro<br>H08   | 0.04            | 6            | түр                                    | as       | 91                  | 65  |                                       | 1.   | k        | 91       |     |          | 77       |                  | _          |  | 49                | 24                                    | 0.0                        |
| .100              | 1               | Ĕ            | 1                                      | 20       | 627                 | 448   |                                       | <del>[                                    </del> | 3        | 91       | 1   | Ē        | 27       |                  | t          |  | 331               | 1 <del>6</del> 5                      | 0.0                        |
| Wire              | <u> </u>        | Ь_           | ــــــــــــــــــــــــــــــــــــــ | F-V      | PEI                 | 17.0  | ļ.,                                   |  | _        | Ľ.,      | L   | _        | · ·      | <u> </u>         | _          | _  | P31               | 100                                   | 7.0                        |
| 108               | 0.08            | þ            | ГУР                                    | 88       | 125                 | F   | F.                                    | F  | В        | F        | F   | -        | <b>E</b> | ŀ                | Ļ          | F  | 60                | 26                                    | 0,0                        |
|                   | 2               |              |  | 20       | 862                 |   | -                                     | -  | 3        | Γ        | Г   | Γ        | Г        | ļ .              | Γ          | F  | 414               | 179                                   | 0.0                        |
| Flat Pro          | ducts           |              | 1                                      | L        | <b>-</b>            |   | ·                                     |  | _        | _        | _   |          |          |                  |            | _  |                   |                                       |                            |
| O\$070            | 0.04            | 0            | TYP                                    | 68       | 42                  | 12  |                                       | -  | 52       | E        | E   | 57       | 8        | F                | Ŀ          | E_   |                   |                                       | 0,0                        |
|                   | 1               |              |  | 20       | 290                 | 83  | <u> </u>                              | <u> </u>   | 52       | Ł        | Ł   | 57       | 8        | <u> </u>         |            | ŀ  | ł                 | <u> </u>                              | 0.0                        |
| Wire              |                 | ,            |  | ,        |                     |   | _                                     |  |          | _        | _   |          |          |                  |            |  |                   |                                       |                            |
| H04               | 80.0            | 0            | TYP                                    | _        | 107                 | -   | <del> </del>                          | <u> </u>   | ۴.       | Ł        | Ł   | _        | ┡        | <u> </u>         | ▙          | <u> </u>   | 53                | 23                                    | G.D                        |
|                   | 2               |              | Щ.                                     | 20       | 738                 | <u> </u>  | <u> </u>                              | <u> </u>   | 9        | Ŀ        | Ł   | Ц        | ᆫ        | <u> </u>         | <u> </u>   | <u> </u>   | 365               | 159                                   | 0.0                        |
| O\$035            | 0.08            | þ            | ΤYΡ                                    |          | 46                  | <del></del>                                     | ┢──                                   | <del> </del>                                     | 50       | •        | Ł   | Ŀ        | F        | <u> </u>         | F          | <del> </del>                                     | -                 | <del></del>                           | 0.0                        |
|                   | <u> </u>        |              |  | 20       | 317                 | <u> </u>  | <u> </u>                              | <u> </u>   | 50       | L        | Ŀ.  | Ŀ        | <u> </u> | <u> </u>         | Ł_         | <u> </u>   | •                 |                                       | 0.0                        |
| Flat Pro<br>OS050 |                 | þ            | ТҮР                                    | 68       | 44                  | 14  | L                                     |  | ĒΩ       | Ε        |     | 91       | 15       |                  | t          | _  | 32                |                                       | 0.0                        |
| ~~~ <del>~</del>  | 1               | <del>Ľ</del> | _                                      | 20<br>20 | <del> </del>        | 97  | <del>[</del>                          | <del>[                                    </del> | _        |          |     |          | 16       |                  | ✐          | <del>[                                    </del> | 32<br>221         | $\vdash$                              | 0.0                        |
| Wîre              | <u>'</u>        | Ц            |  | <u> </u> | P~~                 | <u>r'                                      </u> | <u> </u>                              | <u> </u>   | L.,      | L        | L   | <u>'</u> |          | _                | _          | <u> </u>   | r.c. ,            | Ĺ                                     | r.v                        |
| H62               | 0.08            | o            | TYP                                    | 68       | 82                  | F   | F                                     | F  | 8        | F        | F   | F        | F        | F                | F          | F  | 47                |                                       | 0.0                        |
|                   | Z               | Γ            | _                                      | 20       | 565                 | ļ.  |                                       | Į.   | 8        | -        | F   | Γ        |          | -                |            | ŀ  | 324               |                                       | 0.0                        |
| Flat Pro          | _               | <b></b>      | <del>!</del>                           |          | L'                  | L   |                                       | L  | <u> </u> |          | Ц   | Ц.       | Щ.       | <b></b>          | <u> </u>   |  | . – •             | L                                     |                            |
| H01               | _               | 0            | TYP                                    | 68       | 53                  | 40  | F                                     | F  | 30       | 55       | Ŀ   | Ē.       | 54       | Ţ                | E          | <u> </u>   | 36                |                                       | 0.0                        |
|                   | !               |              |  | 20       | 385                 | 276   | <u> </u>                              | -  | 30       | þΰ       | F   | F        | 54       |                  | F          | 1  | 248               |                                       | 0.0                        |
| OS025             | 0.04            | 0            | TYP                                    | 68       | 48                  | 17  | F                                     | F  |          | Ē        | E   | 89       | 32       |                  | E          | E  | F                 |                                       | 0.0                        |
|                   | 1               |              |  | 20       | 331                 | 117   | ļ                                     | -  | 47       | F        | F   | 89       | 32       |                  | F          | 1  | -                 |                                       | 0.0                        |

<sup>\*</sup>Fatigue Strength: 100 x 10  $^6$ cycles, unless indicated as [N]X 10 $^6$ .

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**Physical Properties** 

|                                  | US Customary                             | Metric                                   |
|----------------------------------|--|--|
| Melting Point - Liquidus         | 1830 F                                   | 999 C                                    |
| Melting Point - Solidus          | 1770 F                                   | 966 C                                    |
| Density                          | 0.313 lb/in <sup>3</sup> at 68 F         | 8.66 gm/cm <sup>3</sup> @ 20 C           |
|                                  | 8.67                                     | 8.67                                     |
| Electrical Resistivity           | 32.4 ohms-cmil/ft @ 68 F                 | 5.39 microhm-cm @ 20 C                   |
| Electrical Conductivity          | 32 %IACS @ 68 F                          | 0.187 MegaSiemens/cm @ 20 C              |
| Thermal Conductivity             | 81.0 Btu · ft/(hr · ft2.ºF)at 68F        | 140.2 W/m · °K at 20 C                   |
| Coefficient of Thermal Expansion | 10.6 ·10 <sup>-6</sup> per °F (68-572 F) | 19.1 ·10 <sup>-6</sup> per °C (20-300 C) |
| Specific Heat Capacity           | 0.09 Btu/lb/ºF at 68 F                   | 377.1 J/kg · <sup>o</sup> K at 293 K     |
| Modulas of Elasticity in Tension | 16000 ksi                                | 110000 MPa                               |
| Modulus of Rigidity              | 6000 ksi                                 | 41370 MPa                                |

**Tempers Most Commonly Used** 

| Flat Products                           |         | _      |        | -     |
|---|---------|--------|--------|-------|
| STRIP, ROLLED H01, H02, H04, H08, OS015 | , OS025 | OS035, | OS050, | OS070 |
| WIRE, ROLLED H02, H08, OS035, OS050     |         |        | •      |       |

| Other        |           |           |        |        |        |
|--------------|-----------|-----------|--------|--------|--------|
| WREH00, H01, | H02, H04, | H06, H08, | OS015, | OS035, | O\$050 |

### Typical Uses Architecture

Spandrels, Medallions, Ornamental Components

### **Builders Hardware**

**Decorative Panels** 

## Consumer

Musical Instrument Parts, Clock Dials, Plaques

#### **Electrical**

Rotor Bars, AC Motors, Battery Caps

#### Industrial

Flexible Hose Bellows, Welding Wire, Flexible Hose, Pump Lines

#### Other

Tokens

Start Another Search

#### DISCLAIMER:

The values listed above represent reasonable approximations suitable for general engineering use. Due to commercial variations in compositions and to manufacturing limitations, they should not be used for specification purposes. See applicable ASTM International specification references.

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# Coppered

# **Search Results**

C26000 (Cartridge Brass, 70%)

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           | Cu   | Fe | Рb  | Zn   |
|-----------|------|----|-----|------|
| Min./Max. |      | 05 | .07 | Rem. |
| Nominal   | 70.0 |    | ,   | 30.0 |

Note: Cu + Sum of Named Elements, 99.7% min.

**Applicable Specifications** 

| Product               | Specification   |
|-----------------------|---|
| Bar                   | ASTM B36, B19<br>SAE J463, J461   |
| Brazing Filler Metal  | FEDERAL QQ-B-650  |
| Cups, Cartridge Case  | ASTM B129<br>MILITARY MIL-C-10375                                       |
| Disk                  | ASTM B19  |
| Plate                 | AMS 4507, 4505<br>ASTM B19, B36   |
| Rod                   | SAE J461, J463  |
| Sheet                 | AMS 4507, 4508, 4505<br>ASTM B19, B36<br>SAE J463, J461                 |
| Shim Stock, Laminated | MILITARY MIL-S-22499  |
| Strip                 | AMS 4507, 4505<br>ASTM B36, B569, B19, B888<br>SAE J463, J461           |
| Tube, Seamless        | ASTM B135<br>FEDERAL WW-T-791<br>MILITARY MIL-T-20219<br>SAE J461, J463 |
| Tube, Welded          | ASTM B587, B587   |
| Wire                  | ASTM B134<br>SAE J463, J461   |

**Common Fabrication Processes** 

Copper.org: Resources: Standards & Properties - Properties of Wrought and Cast Copper Alloys ... Page 2 of 4

No information available.

Fabrication Properties

| Joining Technique              | Suitability     |  |  |  |  |  |
|--------------------------------|-----------------|--|--|--|--|--|
| Soldering                      | Excellent       |  |  |  |  |  |
| Brazing                        | Excellent       |  |  |  |  |  |
| Oxyacetylene Welding           | Good            |  |  |  |  |  |
| Gas Shielded Arc Welding       | Good            |  |  |  |  |  |
| Coated Metal Arc Welding       | Not Recommended |  |  |  |  |  |
| Spot Weld                      | Fair            |  |  |  |  |  |
| Seam Weld                      | Not Recommended |  |  |  |  |  |
| Butt Weld_                     | Good            |  |  |  |  |  |
| Capacity for Being Cold Worked | Excellent       |  |  |  |  |  |
| Capacity for Being Hot Formed  | Fair            |  |  |  |  |  |
| Machinability Rating           | 30              |  |  |  |  |  |

Mechanical Properties (measured at room temperature, 68 F (20 C)

| Mecn     | <u>anicai</u>   | Pro          | pe          | rties     | (mea:               | <u>sured at</u>                                | room                                  | <u>tempe</u>                           | ra         | tu       | re       | , 6          | 8  | F (20    | C)          |            |                   |                     |                            |
|----------|-----------------|--------------|-------------|-----------|---------------------|--|---------------------------------------|--|------------|----------|----------|--------------|----|----------|-------------|------------|-------------------|---------------------|----------------------------|
| Temper   | Section<br>Sizo | Cold<br>Work | Typ/<br>Min | Temp      | Tensile<br>Strength | Yield<br>Strength<br>(0.5% ext.<br>under load) | Yield<br>Strength<br>(0.2%<br>offset) | Yield<br>Strength<br>(0.05%<br>offset) |            | <u>L</u> |          |              |    |          | Bri:<br>Hai | nell<br>d. | Shear<br>Strength | Fatigue<br>Strength | izod<br>Impect<br>Strength |
|          | in.             | ¾.           |             | F         | ksl                 | ksl  | ksi                                   | ksi                                    | %          | Э        | C F      | = 30         | 1  | 500      | 500         | 3000       | œi                | ksi                 | t-ib                       |
|          | mm.             |              |             | С         | MΡα                 | MPa  | МРа                                   | MPa                                    | Γ          | П        | T        | T            |    |          | _           |            | MPa               | MPa                 | J                          |
| Wire     |                 |              |             |           | L.                  | <del></del>                                    | •                                     | <u> </u>                               | _          |          | _        |              |    |          |             |            | L ·               | L.                  | L                          |
| H06      | 0.08            | 0            | ΙΥΡ         | 68        | 124                 |  | -                                     |  | 4          | E. I     | - [      | -  -         |    |          |             | ŀ          |                   |                     | 0.0                        |
|          | 22              |              |             | 20        | 855                 |  | -                                     | -                                      | 4          | F        | -  -     | . F          |    |          | -           |            | -                 | -                   | 0.0                        |
| Tube     |                 |              |             |           |                     |  |                                       |  |            |          |          |              |    |          |             |            |                   |                     |                            |
| H80      | 0.0             | 35           | ΤΥΡ         | _         | 78                  | 64   |                                       |  | 8          | 92       | 1        | 7            | 3  |          | Е           | E          | <u> </u>          |                     | 0.0                        |
|          | 0.0             |              |             | 20        | 538                 | 441  | -                                     | <u>-</u>                               | 8          | 82       | ╌┠       | <b> </b>     | 3  | <u> </u> | ┡           |            | <u> </u>          | -                   | 0.0                        |
| Flat Pro |                 |              |             |           |                     |  |                                       |  |            |          |          |              | _  |          |             |            |                   |                     |                            |
| OS015    |                 |              | ťΥP         |           | 53                  | 22   | -                                     | ·                                      | 54         | П        | -        | 84:          | _  |          | E           | E          | 35                | 14                  | 0.0                        |
|          | 1               |              |             |           | 365                 | 152  | <u> </u>                              | <u> </u>                               | 54         | Łŀ       | -        | 94,          | 3  |          | Ŀ           | <u> </u>   | 241               | 97                  | 0,0                        |
| H02      | 0.04            |              | ΤΥΡ         |           | 52                  | 52   | -                                     | -                                      | 25         | 70       | 1        | 6!           | _  |          |             | E          | 40                | 18                  | 0.0                        |
| L        | 1               |              |             | 20        | 427                 | 359  | -                                     | <u>-</u>                               | 25         | 70       | ⋅ŀ       | 68           | 5  | -        | ┞           | ŀ          | 276               | 124                 | 0.0                        |
| Wire     |                 |              |             |           |                     |  |                                       |  |            |          |          |              |    |          |             |            |                   |                     |                            |
| H00      | 80.0            |              | ΙΥΡ         |           | 58                  |  | -                                     | -                                      | 35         |          | 1        | Ŧ            |    |          | Ш           |            | 38                |                     | 0.0                        |
|          | 2               |              |             | 20        | 400                 |  | <u> </u>                              |  | 35         | Łŀ       | <u>-</u> | ŀ            |    |          |             | <u> </u>   | 262               |                     | 0.0                        |
| H01      | 0.08            |              | ΤΥΡ         | 58        | 70                  | -  |                                       | -                                      | 20         | EJ       | Ι        | E            |    |          | į           | -          | -                 |                     | 0.0                        |
|          | 2               |              |             | <b>20</b> | 483                 | -  | }                                     | -                                      | 20         | ⊦⊦       | ŀ        | Т            |    | -        | -           | ŀ          |                   | -                   | C.O                        |
| Flat Pro | ducts           |              |             | *         |                     |  |                                       |  |            |          |          |              |    |          |             |            | -                 |                     |                            |
| H05      | 0.04            | 0            | ΤΥP         | _         | 86                  | 65   |                                       |  | 5          | 38       | Ŧ        | 76           | j  |          |             | L          | 46                |                     | 0.0                        |
|          | 1               |              |             |           | 593                 | 448  | -                                     |  | 5          | 89       | _        | 78           |    | 1        | 1           | ٠.         | 317               | _                   | 0.0                        |
| 05100    | 0.04            | 0            | ŢΥΡ         | 60        | 44                  | 11   | -                                     |  | 3€         | Ŀŀ       | ŀ        | 411          | Ī  |          | 1           |            | ļ                 | 13                  | 0.0                        |
|          | 1               |              |             | 20        | 303                 | 78   | ŀ                                     | -                                      | 86         | ŀ ŀ      | ŀ        | 411          | i  |          | ŀ           | - 1        |                   | 90                  | 0.0                        |
| 0\$035   | 0.04            | Ū            | TYP         | 68        | 49                  | 17   | -                                     | ,                                      | 57         | Ĺ        | . 6      | 831          | 1  |          | Į,          | Ļ          | 34                | 14                  | 0.0                        |
|          | 1               |              |             | 20        | 338                 | 117  | -                                     | _                                      | 57         | FJ       | Τ,       | <b>88</b> 31 | 1  | , –      | _           |            | 234               | 97                  | 0.0                        |
| H04      | 0.04            | 0            | ΤΥP         | 88        | 76                  | 63   | -                                     | -                                      | 8          | 32       | Ť        | 73           | 1  |          |             |            | 44                | 21                  | 0.0                        |
|          | 1               |              |             | 20        | 524                 | 434  | -                                     | -                                      | 8          | 32       | Ī        | 73           | ,  |          |             |            | 303               | 145                 | 0.0                        |
| Wire     |                 |              |             |           |                     |  |                                       |  | -          | _        | •        |              |    |          | ٠           |            |                   |                     |                            |
| OS015    | 80.0            | O            | ΤYΡ         | 88        | 54                  |  |                                       |  | 56         | EJ       | T        | Ŀ            |    |          |             | E          |                   |                     | 0.0                        |
|          | 2               |              |             | 20        | 372                 |  |                                       | -                                      | 50         | - 1      | T        | Ŧ            | ٦  |          |             |            |                   |                     | 0.0                        |
| OS050    | 80.0            | c            | ΤΥΡ         | 58        | 48                  |  | ·                                     |  | 64         | Ħ        | t        | Ī            | 7  |          |             |            |                   |                     | 0.0                        |
|          | 2               |              |             | 20        | 331                 | -  | -                                     | -                                      | 54         | F        | ŀ        | Ŧ            | ٦  |          |             | F          | -                 |                     | 0.0                        |
| let Pro  | ducte           |              |             |           |                     |  |                                       |  |            |          | •        |              | _  |          |             |            |                   | Lav                 |                            |
| H08      | 0.04            | 0            | ΤΥP         | 88        | 94                  | 65   | -                                     |  | 3          | 91       | ŀ        | 77           | '  |          |             |            | 48                | 23                  | 0 D                        |
|          | ;               | - 7          |             | 20        | 548                 | 448  | -                                     | -                                      | 3          | 31       | F        | 77           |    | -        |             | - 1        | 331               | 159                 | 0.0                        |
| Rod      |                 |              |             |           | _                   |  |                                       |  | _          |          |          | _            | -4 |          |             |            |                   | -                   |                            |
| OS050    | 1               | 0            | TYP         | 68        | 48                  | 18   |                                       |  | 65         | J.       | þ        | 5            | J  |          |             |            | 34                | -                   | 0.0                        |
|          | 25.4            |              |             | 20        | 331                 | 110  | -                                     |  | <b>3</b> 5 | Į Į      | Б        | 4            | T  | -        |             | -          | 234               |                     | 0.0                        |

| H00     | h      | 6  | Ιτγρ     | 68 | 55  | 40  | ŀ              | 1         | 488         | <b>+ +</b>      | F        | ļ.   | Ŀ. | }        | 38             | ŀ  | 0.0 |
|---------|--------|----|----------|----|-----|-----|----------------|-----------|-------------|-----------------|----------|--|----|----------|----------------|--|-----|
|         | 25.4   |    |          | 20 | 379 | 276 | - I            | -         | 4860        | <del>,</del> I- | ŀ        | Ţ  | F  | F        | 248            |  | 0,0 |
| Vire    |        |    |          |    |     |     |                |           |             |                 |          |  |    | 1        |                |  |     |
| H08     | 0.08   | q  | TYP      | 68 | 130 | _ } |                | E         | 3 -         | FF              | ŀ        | ŀ  | Ι. | ŀ        | 60             | 22   | 0.0 |
|         | 2      |    |          | 20 | 896 | T   | -              | -         | 3 -         | Ħ               | F        |  | F  | F        | 414            | 152  | 0,0 |
| Tube    |        |    |          |    | _   |     |                |           |             |                 |          |  |    |          | -              |  |     |
| OS025   | 0.0    | 0  | TYP      | 66 | 52  | 20  | 1              | -         | 55-         | <b>F</b> 17     | 5 40     | -  | 1  | Ļ        |                | 1-   | 0.0 |
|         | 0.0    | Ĭ  |          | 20 | 359 | 138 | 1              | ļ         | 55-         | Ιħ              | 5 40     | -  | Ţ  | 1        |                | <u> </u>   | 0.0 |
| Flot Pr | oducts |    |          |    |     |     |                |           |             |                 |          | •  |    | _        |                |  |     |
| OS070   | 0.04   | G  | TYP      | 68 | 46  | 14  |                | -         | 65          | Fβ              | B 15     | -  | Ł. | ŀ        | 32             | 13   | 0.0 |
|         | 1      |    | Π        | 20 | 317 | 97  | -              | $\top$    | <b>6</b> 5- | ΙŢ              | B 15     | -  | F  | -        | 221            | 90   | 0.0 |
| Rod     |        |    |          |    |     |     |                |           |             |                 |          |  |    | •        |                |  | _ ' |
| H02     | 1      | 20 | TYP      | 68 | 70  | 52  |                | ŀ         | 30 80       | ŧΕ              | E        | ļ  | E  | F        | 42             | 22   | 0.0 |
|         | 25.4   |    |          | 20 | 483 | 359 | 1              | T-        | 3080        | ŦŦ              | T        |  | ļ  | Ļ        | 290            | 152  | 0,0 |
| Vire    |        |    |          |    |     |     |                |           |             |                 |          | -  | -  |          |                |  |     |
| OS035   | 0.08   | n  | TYP      | 88 | 50  | -   | Ŀ              | ŀ         | 60          | ΕE              | F        | <u> </u>   | F  | F        | 34             | F  | 0.0 |
|         | 2      |    |          | 20 | 345 | 1   | -              | -         | 60-         | ŀŀ              | ļ.       | -  | F  | -        | 234            | -  | 0.0 |
| Flat Pr | oducts |    |          |    |     |     |                | · · · · · |             |                 |          |  |    |          |                |  |     |
| 05050   | 0.04   | þ  | TYP      | 68 | 47  | 15  |                | Ŀ         | 62-         | - 6             | 4 28     | F  | -  | <u> </u> | ŀ              | F  | 0.0 |
|         | 1      |    | 1        | 20 | 324 | 103 | -              | F         | 62          | F 18            | 4 26     | ļ.   | F  | ļ        | Ļ              | F  | 0,0 |
| Wire    |        |    |          |    |     |     | _              |           |             |                 |          | A  | •  |          | •              |  |     |
| 05025   | 0.08   | 0  | TYP      | 68 | 52  | . L | -              |           | 58-         | FF              | <b>F</b> | -  | F  | ŀ        | ŀ              | F  | 0.0 |
|         | 2      |    |          | 20 | 359 | -   | -              | _         | 58-         | FF              | F        | ļ  | -  | F        | -              | F  | 0.0 |
| Tube    |        |    |          |    |     |     |                |           |             |                 |          |  |    |          |                |  |     |
| OS050   | 0.0    | 0  | TYP      | 68 | 47  | 15  |                | ŀ.,       | 65          | ŀķ              | 178      | ŀ  | E  | -        | F              | F  | 0.0 |
|         | 0.0    | Ш. |          | 20 | 324 | 103 | -              | Ŧ         | 85 -        | FB              | 426      | -  | Ŧ  | F        | ļ              | Ţ-   | 0.0 |
| lat Pr  | oducts |    |          |    | _   |     |                |           |             |                 |          | <del></del>                                      |    | •        |                | -  |     |
| H10     | 0.04   | 0  | TYP      | 68 | 99  | 65  | ŀ              | Ē.        | 3 93        | EL.             | 76       | F  | Ŀ  | Į.       | F              | F  | 0.0 |
|         | 1      | 1  | <b> </b> | 20 | 283 | 448 | -              | F         | 3 93        | FF              | 78       | -  | Ţ  | Ļ        | -              | Į.   | 0.0 |
| 101     | 0.04   | 0  | TYP      | 36 | 54  | 40  | -              | +         | 43 65       | Ļţ.             | 54       | <del>                                     </del> | ナー | ļ        | 36             | -  | 6.0 |
|         | 1      |    |          | 20 | 372 | 276 |                | T-        | 4355        | IT              | 54       |  | ┰  |          | 248            | <del>                                     </del> | 0.0 |
| 05025   | 0.04   | 0  | TΥP      | 68 | 51  | 19  | +              | +         | 55          | 17              | -        | <del>[</del>                                     |    | ┢        | <del>L -</del> | +  | 0.0 |
|         | 1      | 1  | _        | 20 | 352 | 131 | <del>-  </del> | 1-        | 55          | -               | 236      | <del> </del>                                     | +- | ┝┷       | ┼              | <del>-</del> {                                   | 0.0 |

<sup>\*</sup>Fatigue Strength: 100 x 10  $^6$ cycles, unless indicated as [N]X 10 $^6$ .

**Physical Properties** 

|                                  | US Customary  | Metric                                   |
|----------------------------------|---|--|
| Melting Point - Liquidus         | 1750 F  | 954 C                                    |
| Melting Point - Solidus          | 1680 F  | 916 C                                    |
| Density                          | 0.308 lb/in <sup>3</sup> at 68 F                      | 8.53 gm/cm³ @ 20 C                       |
| Specific Gravity                 | 8.53  | 8.53                                     |
| Electrical Resistivity           | 37.0 ohms-cmil/ft @ 68 F                              | 6.15 microhm-cm @ 20 C                   |
| Electrical Conductivity          |   | 0.164 MegaSiemens/cm @ 20 C              |
| Thermal Conductivity             | 70.0 Btu · ft/(hr · ft2·°F)at 68F                     | 121.2 W/m ⋅ ºK at 20 C                   |
| Coefficient of Thermal Expansion | 111.1 ·10 <sup>-8</sup> per <sup>o</sup> F (68-572 F) | 20.0 ·10 <sup>-6</sup> per °C (20-300 C) |
| Specific Heat Capacity           | 0.09 Btu/lb/ºF at 68 F                                | 377.1 J/kg ⋅ ºK at 293 K                 |
| Modulas of Elasticity in Tension |   | 110000 MPa                               |
| Modulus of Rigidity              | 6000 ksi  | 41370 MPa                                |

**Tempers Most Commonly Used** 

| Flat Products |  |
|---------------|--|
|               | H02, OS070, OS100  |
|               | H01, H02, OS035, OS050, OS070  |
| STRIP, ROLLED | H01, H02, H04, H06, H08, H10, OS015, OS025, OS035, OS050, OS070, OS100 |
|               |  |

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WIRE, DRAWN | H02, OS050 WIRE, ROLLED | H02, H04, H06, OS035, OS050, OS070, OS100

| Other  |                                       |           |
|--------|---------------------------------------|-----------|
| SHAPES | M30                                   | -         |
| TUBE   | H58, H80, OS025, OS050                |           |
| WIRE   | H00, H01, H06, H08, OS015, OS025, OS0 | 35, OS050 |

### Typical Uses

**Architecture** 

Grillwork

Automotive

Electrical Connectors, Radiator Cores, Tanks, Heater Cores, Radiator Tanks, Odometer Contacts, Thermostats, Radiator Tube

**Builders Hardware** 

Decorative Hardware, Door Knobs, Finish Hardware, Hinges, Kick Plates, Locks, Push Plates

Consumer

Bird Cages, Costume Jewelry, Syringe Parts, Chain Links, Watch Parts, Coinage, Etched Articles, Pen/Pencil Inserts and Clips, Lamps, Shelfs - Electrical Sockets, Buttons, Snaps, Planters, Fireplace Screens

Electrical

Reflectors, Lamp Fixtures, Flashlight Shells, Screw Shells, Terminal Connectors

**Fasteners** 

Eyelets, Screws, Grommets, Rivets, Pins, Fasteners

Industrial

Sound Proofing Equipment, Heat Exchangers, Wire Screens, Pump Cylinders, Tubing for Instruments and Machines, Air Pressure Conveyer Systems, Liners, Springs, Power Cylinders, Pumps, Bead Chain, Chain Ordnance

Ammunition Cartridge Cases, Ammunition, Mechanical Housings for Lighters, Shells - Mechanical Housings for Ammunition

Other

Washers, Stencils

Plumbing

Faucet Escutcheons, Plumbing Accessories, Fittings, Bathroom Fixtures, Traps, Plumbing Brass Goods

Start Another Search

### DISCLAIMER:

The values listed above represent reasonable approximations suitable for general engineering use. Due to commercial variations in compositions and to manufacturing limitations, they should not be used for specification purposes. See applicable ASTM International specification references.

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## **Search Results**

C31400 (Leaded Commercial Bronze)

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           |           |    |         |   | Zn   |
|-----------|-----------|----|---------|---|------|
| Min./Max. | 87.5-90.5 | 10 | 1.3-2.5 | 7 | Rem. |
| Nominal   | 89.0_     | -  | 1.9     | - | 9.1  |

Note: Cu + Sum of Named Elements, 99.6% min.

**Applicable Specifications** 

| Product | Specification        |
|---------|----------------------|
| Bar     | ASTM B140            |
| Rod     | ASTM B140            |
| Shapes  | ASTM B140            |
| Valves  | MILITARY MIL-V-18436 |

# **Common Fabrication Processes** Machining

**Fabrication Properties** 

| Joining Technique              | Suitability     |
|--------------------------------|-----------------|
| Soldering                      | Excellent       |
| Brazing                        | Good            |
| Oxyacetylene Welding           | Not Recommended |
| Gas Shielded Arc Welding       | Not Recommended |
| Coated Metal Arc Welding       | Not Recommended |
| Spot Weld                      | Not Recommended |
| Seam Weld                      | Not Recommended |
| Butt Weld                      | Fair            |
| Capacity for Being Cold Worked | Good            |
| Capacity for Being Hot Formed  | Poor            |
| Machinability Rating           | 80              |

| Mechanical Properties (measured at room temperature, 68 F (20 C) |                |      |     |      |         |  |                   |                   |    |          |         |         |       |         |      |   |
|--|----------------|------|-----|------|---------|--|-------------------|-------------------|----|----------|---------|---------|-------|---------|------|---|
| Төсц   | per<br>Section | Cold | Typ | Temp | Tanzilo |  | Yield<br>Steenath | Yield<br>Strength | Εì | Rockwell | Vickene | Brineil | Sheer | Estínua | izod | ŀ |

|        | Size  | Work | Min |    | Strength | (0.6% ext.<br>under load) | (0.2%<br>offaet) | (0.05%<br>offset) |    | Ľ | an  | ine | 255 | На  | rd. | Ha  | rd.  | Streng | thStrength | Strengti |
|--------|-------|------|-----|----|----------|---------------------------|------------------|-------------------|----|---|-----|-----|-----|-----|-----|-----|------|--------|------------|----------|
|        | in.   | *    |     | F  | ksi      | ksi                       | ksi              | lsi.              | *  | В | F   | F   | 30  | 500 | 0   | 500 | 3000 | ksi .  | ksi N-Ib   | It-lib   |
|        | itte: |      |     | C  | MPa      | MPa                       | MPa              | MPa               | Т  | Ī | T   | Ī   |     |     |     | 1   |      | MРа    | MPa        | j.       |
| Rod    |       |      |     |    |          |                           |                  |                   | _  | _ |     |     |     |     |     |     | _    |        |            |          |
| H02    | 0.5   | 25   | ΤŸΡ | 33 | 55       | 50                        | L                | F                 | 14 | ķ | 1   | E   | E   | Ŀ   |     | ŀ   | Ŀ    | 31     |            | 0.0      |
|        | 12.7  |      |     | 20 | 379      | 345                       | -                | F                 | 14 | ĥ | 1   | F   | ļ   | Ţ   |     |     | F    | 214    | -          | 0.0      |
| Ber    |       |      |     |    |          |                           | •                |                   |    |   | _   | _   |     |     |     |     |      |        |            | •        |
| H02_   | 0.25  | 0    | ΤΥΡ | 68 | 55       | 50                        | -                | J.                | 12 | ŝ | 1 E | F   | Ŀ   | Τ.  |     | }   | Į.   | 31     |            | 0.0      |
|        | 6.35  |      |     | 20 | 379      | 345                       |                  | F                 | 12 | 6 | 1   | F   | F   | F   |     | -   | -    | 214    | -          | 0.0      |
| Rod    |       |      |     |    |          |                           |                  |                   |    | _ |     |     |     |     |     |     |      |        | _          |          |
| Q\$050 | 1     | 0    | TYP | 68 | 37       | 12                        | -                | F .               | 45 | E | E   | S   | L   | ļ   |     | 1   | F    | 24     | -          | 0.0      |
|        | 25.4  |      |     | 20 | 255      | <b>8</b> 3                | -                | 1                 | 45 | F | F   | 55  | Ŧ   | F   |     | F   | F    | 165    | -          | 0.0      |
| H04    | 1     | 20   | Т/Р | 85 | 52       | 45                        | F .              | -                 | 18 | 5 | ī   | E   | ŀ   | F   |     | F   | F    | 30     | -          | 0.0      |
|        | 25.4  |      |     | 20 | 359      | 310                       | -                | F                 | 18 | ő | 타   | F   | F   | ŀ   |     | F   | -    | 207    | -          | 0.0      |
| H02    | C.25  | 37   | ΤYΡ | 69 | 60       | 55                        | -                |                   | 10 | Б | ŧ   | Ē   | F   | Ē.  |     | ŀ   | ļ-   | 32     | 1          | 0.0      |
|        | 6.35  |      |     | 20 | 414      | 379                       | L                | ļ                 | 10 | ß | 5   | Ļ   | Ţ   | Ļ   |     | Ţ   | 1    | 221    | 1          | 0.0      |

<sup>\*</sup>Fatigue Strength: 100 x 10 <sup>6</sup>cycles, unless indicated as [N]X 10<sup>6</sup>.

**Physical Properties** 

|                                  | US Customary  | Metric                                    |
|----------------------------------|---|---|
| Melting Point - Liquidus         | 1900 F  | 1038 C                                    |
| Melting Point - Solidus          | 1850 F  | 1010 C                                    |
| Density                          | 0.319 lb/in <sup>3</sup> at 68 F                      | 8.83 gm/cm <sup>3</sup> @ 20 C            |
| Specific Gravity                 | 8.83  | 8.83                                      |
| Electrical Resistivity           | 24.7 ohms-cmil/ft @ 68 F                              | 4.11 microhm-cm @ 20 C                    |
| Electrical Conductivity          | 42 %IACS @ 68 F                                       | 0.246 MegaSiemens/cm @ 20 C               |
| Thermal Conductivity             | 104.0 Btu · ft/(hr · ft2.ºF)at 68F                    | 180.0 W/m ⋅ ºK at 20 C                    |
| Coefficient of Thermal Expansion | 10.2 · 10 <sup>-6</sup> per <sup>o</sup> F (68-572 F) | 18.4 · 10 <sup>-6</sup> per °C (20-300 C) |
| Specific Heat Capacity           | 0.09 Btu/lb/ºF at 68 F                                | 377.1 J/kg · °K at 293 K                  |
| Modulas of Elasticity in Tension | 17000 ksi   | 117000 MPa                                |
| Modulus of Rigidity              | 6400 ksi  | 44130 MPa                                 |

### **Tempers Most Commonly Used**

| Flat | Products |      |      | .,   |       |
|------|----------|------|------|------|-------|
| BAR  | , DRAWN  | H02. | H04, | O60, | OS050 |

| Other |      | -    |      |       |
|-------|------|------|------|-------|
| ROD   | H02, | H04, | O60, | OS050 |
| SHAPE | SM30 |      |      |       |

### Typical Uses

**Builders Hardware** 

Door Knobs

Electrical

Connectors for Wire and Cable, Electrical Plug Type Connectors

**Fasteners** 

Screws, Nuts

Industrial

Pickling Fixtures, Pickling Racks, Pickling Crates, Screw Machine Parts

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## Copperate

### **Search Results**

C33000 (Low Leaded Brass (Tube))

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           |           | Fe  |      | Zn   |
|-----------|-----------|-----|------|------|
| Min./Max. | 65.0-68.0 | .07 | .257 | Rem. |
| Nominal   | 66.0      |     | .50  | 33.5 |

Note: Cu + Sum of Named Elements, 99.6% min.

Applicable Specifications

| Product       | Specification        |
|---------------|----------------------|
| Tube, Seamles | s AMS 4555, 4554     |
|               | ASTM B135            |
|               | FEDERAL WW-T-791     |
|               | MILITARY MIL-T-46072 |
|               | SAE J463, J461       |

### **Common Fabrication Processes**

Forming and Bending, Machining, Piercing and Punching

**Fabrication Properties** 

| Joining Technique              | Suitability     |
|--------------------------------|-----------------|
| Soldering                      | Excellent       |
| Brazing                        | Good            |
| Oxyacetylene Welding           | Fair            |
| Gas Shielded Arc Welding       | Fair            |
| Coated Metal Arc Welding       | Not Recommended |
| Spot Weld                      | Fair            |
| Seam Weld                      | Not Recommended |
| Butt Weld                      | Fair            |
| Capacity for Being Cold Worked |                 |
| Capacity for Being Hot Formed  | Poor            |
| Machinability Rating           | 60              |

Mechanical Properties (measured at room temperature, 68 F (20 C)

| Section | Cold | Typ/ | Tensila |        |   | Yiaid<br>Strength | Rockwall | Vickens | Brinell  | Shoar  | Fati | aue.  | Izod |  |
|---------|------|------|---------|--------|---|-------------------|----------|---------|----------|--------|------|-------|------|--|
|         |      | ,,,, |         | р 4д с | L | Lan and all       | NOURHAII | *1000   | C1114011 | D11001 | P AU | yue i | PLOG |  |

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| Temper | Size | Work | Min    | Temp | Strength | (0.5% ext.<br>under load) | (0.2%<br>offset) | (0.05%<br>offset) | Ei | На  | rd | ne:        | 55  | Hard. | Had | d.   | Strength | Strongth* | impact<br>Strength |
|--------|------|------|--------|------|----------|---------------------------|------------------|-------------------|----|-----|----|------------|-----|-------|-----|------|----------|-----------|--------------------|
|        | n.   | *    | $\Box$ | F    | ksi      | ksi                       | ksi              | (3)               | 36 | В   | G  | F          | 30T | 500   | 500 | 3000 | i,si     |           | R-ID               |
|        | mm.  |      |        | Ç    | MPa      | MPa                       | MPa              | MPa               | T  |     | П  |            |     | •     | T   |      | MPa      | MPa       | į                  |
| Tube   |      |      |        |      |          |                           | -                |                   |    |     |    | _          |     |       |     |      |          |           |                    |
| OS025  | 0.0  | 0    | qyr    | 68   | 52       | 20                        |                  | E                 | 50 | - ] | Ŀŀ | 73         | 37  | -     | F   | F    | F        | -         | 0.0                |
|        | 0.0  |      | •      | 20   | 359      | 138                       | ļ .              | ŀ                 | 50 | F   | П  | 75         | 37  | -     | Ţ.  | -    |          | ."        | 0.0                |
| H04    | 0.0  | 35   | TΥP    | 68   | 75       | 60                        |                  |                   | 7  | 80  | Ħ  | _          | 69  | _     | Ŧ   | ┢    | -        |           | 0.0                |
|        | 0.0  |      |        | 20   | 517      | 414                       |                  | -                 | 7  | 80  | П  | . ]        | 69  | F     | T   |      |          | _         | 0.0                |
| OS050  | 0.0  | 0    | TYP    | 68   | 47       | 15                        |                  | ļ —               | 60 | ۳   | H  | <b>5</b> 4 | 26  | _     | +   |      | $\vdash$ |           | 0.0                |
|        | 0.0  | T    |        | 20   | 324      | 103                       | _                | F                 | 60 | Г   | П  | 94         | 26  |       | T   | F    |          |           | 3.0                |

<sup>\*</sup>Fatigue Strength: 100 x 10 <sup>6</sup>cycles, unless indicated as [N]X 10<sup>6</sup>.

**Physical Properties** 

|                                  | US Customary                             | Metric                                   |
|----------------------------------|--|--|
| Melting Point - Liquidus         | 1720 F                                   | 938 C                                    |
| Melting Point - Solidus          | 1660 F                                   | 904 C                                    |
| Density                          | 0.307 lb/in <sup>3</sup> at 68 F         | 8.5 gm/cm <sup>3</sup> @ 20 C            |
| Specific Gravity                 | 8.5                                      | 8.5                                      |
| Electrical Resistivity           | 39.9 ohms-cmil/ft @ 68 F                 | 6,63 microhm-cm @ 20 C                   |
| Electrical Conductivity          |  | 0.152 MegaSiemens/cm @ 20 C              |
| Thermal Conductivity             | 67.0 Btu ft/(hr ft2.ºF)at 68F            |  |
| Coefficient of Thermal Expansion | 11.2 ·10 <sup>-6</sup> per °F (68-572 F) | 20.2 ·10 <sup>-6</sup> per °C (20-300 C) |
| Specific Heat Capacity           | 0.09 Btu/lb/ºF at 68 F                   | 377.1 J/kg ⋅ ºK at 293 K                 |
| Modulas of Elasticity in Tension | 15000 ksi                                | 103400 MPa                               |
| Modulus of Rigidity              | 5600 ksi                                 | 38610 MPa                                |

### Tempers Most Commonly Used

| Other    |      |        |       |
|----------|------|--------|-------|
| TUBE H58 | H80, | OS025, | OS050 |

### Typical Uses

Industrial

Power and Pump Cylinder Liners, Power and Pump Cylinders

Ordnance

**Primers** 

Plumbing

Plumbing Accessories, Pump Lines, Trap Lines, J Bends, Plumbing Brass Goods

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## Copperati

### **Search Results**

C33200 (High Leaded Brass (Tube))

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           |           |     |         | Zn _ |
|-----------|-----------|-----|---------|------|
| Min./Max. | 65.0-68.0 | .07 | 1.5-2.5 | Rem. |
| Nominal   | 66.0      | ļ   | 2.0     | 32.0 |

Note: Cu + Sum of Named Elements, 99.6% min.

**Applicable Specifications** 

| Product | Specification        |
|---------|----------------------|
| Tube    | AMS 4558             |
|         | ASTM B135            |
|         | MILITARY MIL-T-46072 |

### **Common Fabrication Processes**

Forming and Bending, Machining, Piercing and Punching

**Fabrication Properties** 

| Joining Technique              | Suitability     |
|--------------------------------|-----------------|
| Soldering                      | Excellent       |
| Brazing                        | Good            |
| Oxyacetylene Welding           | Fair            |
| Gas Shielded Arc Welding       | Fair            |
| Coated Metal Arc Welding       | Not Recommended |
| Spot Weld                      | Fair            |
| Seam Weld                      | Not Recommended |
| Butt Weld                      | Fair            |
| Capacity for Being Cold Worked | Excellent       |
| Capacity for Being Hot Formed  | Poor            |
| Machinability Rating           | 60              |

Mechanical Properties (measured at room temperature, 68 F (20 C)

| Temper | Section<br>Size | Cold<br>Work | Typ/<br>Min | Temp |  | Strength<br>(0.2% | Yleid<br>Strength<br>(0.05%<br>offset) | ΕI | Ro<br>Ha | ckn | 73   <br> 43   3 | Vickens<br>Hard. | Brt<br>Hai | nell<br>rd. | Shear<br>Strength | Fatigue<br>Stroogth | tzod<br>Impact<br>Strength |
|--------|-----------------|--------------|-------------|------|--|-------------------|--|----|----------|-----|------------------|------------------|------------|-------------|-------------------|---------------------|----------------------------|
|        |                 |              |             |      |  |                   |  | П  |          | Т   | Π                |                  | Ī          | Ĭ           |                   |                     |                            |

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|       | in. | *            | Ī   | F  | ksl | ksi | ksi    | ksi | <b> </b> 46 |    | d   | bo            | T <b>5</b> 00 | 500 | 3000 | ksi  | ksi  | R-Ib |
|-------|-----|--------------|-----|----|-----|-----|--------|-----|-------------|----|-----|---------------|---------------|-----|------|--|------|------|
|       | mm. |              |     | c  | MPa | MPa | МРа    | MPa |             |    | П   |               |               |     |      | мРа  | MPa  | J.   |
| Tube  |     |              |     |    |     |     |        | -   | -           |    |     |               |               |     |      | 1  |      |      |
| OS025 | 0.0 | _ <b>(</b> 0 | TYP | 60 | 52  | 20  | -      | E   | 50          | į. | Ð   | 5 37          | F             | T   | F    |  | -    | 0.0  |
|       | 0.0 |              |     | 20 | 359 | 138 | -      | 1   | 50          | -  | - 7 | '5 <b>3</b> 7 | -             | -   | -    | -  | ).   | 0.0  |
| H04   | 0.0 | 35           | TYP | 68 | 75  | 60  | $\Box$ |     | 7           | 80 | Ţ   | 39            | 1             | ⇉   | E    |  | 1    | 0.0  |
|       | 0.0 |              | T   | 20 | 517 | 414 | F      | Ţ   | 7           | 9  | Π.  | 69            | 1             | -   | F    | <u>,                                    </u> | Ţ. — | 0.0  |
| OS050 | 0.0 | 0            | TŸF | 68 | 47  | 15  |        | -   | 60          | -  | E.K | 4 26          |               | F   | F    | ,  | T    | 0.0  |
|       | 0.0 |              |     | 20 | 324 | 103 | -      | Ŧ   | 80          |    | П   | 4 26          | -             | L   | -    |  | F    | 0.0  |

\*Fatigue Strength: 100 x 10 <sup>6</sup>cycles, unless indicated as [N]X 106.

**Physical Properties** 

|                                  | US Customary   | Metric                                    |
|----------------------------------|--|---|
| Melting Point - Liquidus         | 1710 F   | 932 C                                     |
| Melting Point - Solidus          | 1650 F   | 899 C                                     |
| Density                          | 0.308 lb/in <sup>3</sup> at 68 F                     | 8.53 gm/cm <sup>3</sup> @ 20 C            |
| Specific Gravity                 | 8.53   | 8.53                                      |
| Electrical Resistivity           | 39.9 ohms-cmil/ft @ 68 F                             | 6.63 microhm-cm @ 20 C                    |
| Electrical Conductivity          | 26 %IACS @ 68 F                                      | 0.152 MegaSiemens/cm @ 20 C               |
| Thermal Conductivity             | 67.0 Btu · ft/(hr · ft2.ºF)at 68F                    | 116.0 W/m · ºK at 20 C                    |
| Coefficient of Thermal Expansion | 11.3 ·10 <sup>-6</sup> per <sup>o</sup> F (68-572 F) | 20.3 · 10 <sup>-8</sup> per °C (20-300 C) |
| Specific Heat Capacity           | 0.09 Btu/lb/°F at 68 F                               | 377.1 J/kg · °K at 293 K                  |
| Modulas of Elasticity in Tension |  | 103400 MPa                                |
| Modulus of Rigidity              | 5600 ksi   | 38610.MPa                                 |

**Tempers Most Commonly Used** Other

TUBE H58, H80, OS025, OS050

#### Typical Uses

Industrial

Screw Machine Products, Power and Pump Cylinder Liners, Power and Pump Cylinders, Hydraulic Controls

### Ordnance

**Primers** 

### Plumbing

Plumbing Accessories, Plumbing Brass Goods

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### Search Results

C33500 (Low-Leaded Brass)

Last Updated: Jul 06, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           | C         | Fe <sup>(1)</sup> | РЬ   | Zn   |
|-----------|-----------|-------------------|------|------|
| Min./Max. | 62.0-65.0 | .15               | .257 | Rem. |
| Nominal   | 63.5      | -                 | .50  | 36.0 |

(1) For flat products, the iron shall be .10% max. Note: Cu + Sum of Named Elements, 99.6% min.

**Applicable Specifications** 

| Product | Specification |
|---------|---------------|
| Bar     | ASTM B121     |
| Plate   | ASTM B121     |
| Sheet   | ASTM B121     |
| Strip   | ASTM B121     |

### **Common Fabrication Processes**

Blanking, Drawing, Machining, Piercing and Punching, Stamping

Fabrication Properties

| Suitability     |
|-----------------|
| Excellent       |
| Good            |
| Fair            |
| Fair            |
| Not Recommended |
| Fair            |
| Not Recommended |
| Fair            |
| Good            |
| Poor            |
| 60              |
|                 |

Mechanical Properties (measured at room temperature, 68 F (20 C)

|   | emper | Section<br>Size | Cold<br>Work | Typ/<br>Min | Temp | Strength | Strongth | Strength<br>(0.2% | Yield<br>Strength<br>(0.05%<br>offset) | EΙ | Ro<br>Ha | ckv<br>rdn | voli<br>C35 |    | Vickens<br>Hard, | Bri:<br>Har | ness<br>rd. | Shear<br>Strength | Fatigue<br>Strongth | izod<br>Impact<br>Strengih |
|---|-------|-----------------|--------------|-------------|------|----------|----------|-------------------|--|----|----------|------------|-------------|----|------------------|-------------|-------------|-------------------|---------------------|----------------------------|
| Ţ |       | in.             | %            |             | ٦    | ksi      | ksi      | ksi               | ksi                                    | χ, | В        | c F        | þ           | 77 | 500              | 500         | 3000        | kai               | ksi                 | t-Ib                       |
| V |       |                 |              |             |      |          |          |                   |  | Г  |          | T          | T           | 7  |                  | Г           | П           |                   |                     |                            |

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|                   |  | _              | _                                     |             | _         |  |   |  |                 |            | _        |          | _        |   |              | _  |  | _            |
|-------------------|--|----------------|---------------------------------------|-------------|-----------|--|---|--|-----------------|------------|----------|----------|----------|---|--------------|--|--|--------------|
| 71-4 D.           | mm,  | L              | <u> </u>                              | c           | МРа       | MPa  | MPa   | MPa  | <u> </u>        | Ш          |          |          |          | Ì   | <u>L</u>     | MPs  | MPa  | þ            |
| Flat Pro<br>H02   | 0.04   | ю              | ТҮР                                   | 68          | E1        | 50   | 7   | <del></del>                                      | haha            | J I        | -        | ~ 5      |          | <del>,                                     </del> |              | Lis  |  | lo o         |
| 102               | 1, 1   | ₽—             | 1175                                  | 20          | 61<br>421 | 345  | <del>-</del>                                      | <del>-</del>                                     | 2370            | -          | -        | 65<br>ec | È        | 卜   | <del>-</del> | 40   |  | 0.0          |
| Rod               | <u>l'</u>                                    |                | <u> </u>                              | μU          | 721       | 343  | 1   | 1  | 2370            | <u>ት</u>   |          | 65       | <u> </u> | <u>t</u> _  | <u> </u>     | 276  | <u> </u>   | 0.0          |
| O60               | 1.35   | b              | SMIN                                  | 68          | 40        | 15   | ī.  | <del></del>                                      | 30              | П          | _        | _        | Γ.       | _   |              | , -  |  | lb o         |
| -                 | 34.9   | <del>ľ -</del> | Samo                                  | 20          | 276       | 103  | f -   | ₽  | 30              | H          | Η        | _        | ├        | F   | r –          | <del>-</del>                                     | _  | 0.0          |
| C60               | 0.75   | 6              | Child                                 | _           |           |  | +   | <b>!</b>   |                 | Н          | Ц        | _        | <u> </u> | <b>!</b> —  | <u> </u>     | <b>!</b> —                                       | <del>-</del> -                                   | 0,0          |
| ~~                | 19,1   | ۲              | SMIN                                  | _           | 44        | 15   | <del>-</del>                                      | <del>}</del>                                     | <u> </u>        | H          | 4        | -        | <u> </u> | F   | <del>-</del> | <del>                                     </del> | +  | 0.0          |
| S.C.O.            |  | <u>L</u>       | 51411                                 | 20          | 303       | 103  | ↓   | <del> </del>                                     | 25              | Н          |          | _        |          |   | ᆣ            | <u> </u>   |  | 0.0          |
| <u>06</u> 0       | < 0.50                                       | p_             | SMIN                                  | _           | 46        | 16   | ┿—  | ╄  | 50              | Ħ          | 4        |          | <u> </u> | Ł   | ┡            | <u> </u>   | +  | 0.0          |
|                   | <12.7  | <u> </u>       | ل                                     | 20          | 317       | 110  | <u> </u>  | <u> </u>   | <u> 1994</u>    | H          | _        |          | <u> </u> | Ŀ_  | <u> </u>     | -  | <u>. t</u>                                       | 0.0          |
| Flat Pro<br>OS035 |  | 0              | ΤΥP                                   | 88          | 49        | 17   | _   | <del></del>                                      | Izal            | 11         | 1        | 5.4      | _        |   | r            | a .  | <del></del>                                      | <b>b</b> a   |
| 55035             | 1  | ۳              | 117                                   | 20          | •         | 7  | ╀╼┈   | <del> </del>                                     | 57              | -          | 88       | _        |          | ╄   | ┡            | 34   | +  | 0.0          |
| Rod               | <u>l'</u>                                    | <u> </u>       | <u> </u>                              | ķυ          | 338       | 117  | <u> </u>  | <u>t                                     </u>    | 57              | Ŀ          | 88       | 31       | <u> </u> | <u>t                                    </u>      |              | 234  | r  | 0.0          |
| H02               | <0.50  | 6              | SMIN                                  | e e         | 57        | 25   | Υ   | т .  | 7 F             | 7 1        | _        | _        |          | _   | г —          |  |  | 6.0          |
|                   | <12.7  | Ť              | Similar                               | 20          | 393       | 172  | <del></del>                                       |  | <del> </del>    | H          | 4        |          |          | F   | ┡            |  | +  | 0.0          |
| Flat Pro          | <u> </u>                                     | <u> </u>       | <u> </u>                              | kΛ          | p33       | 1''2   | <u> </u>  | <u>r</u>   | ľ               | 11         | 1        | -        | <u> </u> | <u> </u>  | <u> </u>     | <u> </u>   | <u>t                                     </u>    | 0.0          |
| HO4               | 0.04   | o              | ΤΥΡ                                   | 88          | 74        | 60   | T   | <u>r</u>   | 8 80            | II         |          | 69       |          | _   |              | 43   | τ .  | <b>b</b> .o  |
|                   | 1  | Ť              |                                       | 20          | 510       | 414  | t   | t  | 8 80            | -          | -        | 69<br>69 |          | t   |              | 296  | <del>[</del>                                     | 0.0          |
| Rod               | <u> </u>                                     | Ч              | Ь.                                    | <u> </u>    | P.0       | * 1.7  | <u> </u>  |  | L L             | Ц          |          | .,,3     |          | <u> </u>  |              | K 20   | Ι.   | P.V          |
| HO1               | 0.75   | р              | SMAX                                  | <b>1</b> 68 | 62        | F -  | F   | F  | <u> </u>        | ļļ         | T        |          |          | F   | Į.           | L .  | Ţ  | 6.0          |
|                   | 19.1   | П              | ī                                     | 20          | 427       | 1  | T   |  | tt              | Ħ          | ╗        |          |          |   | <u> </u>     | t -  | $t^{-}$  | 0.0          |
| HO1               | <0.50  | 6              | SMIN                                  | _           | 52        | 25   | t   | $\leftarrow$                                     | <del>la</del> t | Н          | $\dashv$ |          |          | ┢   | ┝            | -  | <del></del>                                      | 0.0          |
|                   | <12.7  | f              | 314154                                | 20          | 358       | 172  | t   | [  | 101-            | H          | ┪        |          |          | F   | F-           | f  | <del>-                                    </del> | 0.0          |
| H01               | 1.35   | Ь              | SMIN                                  |             | 42        | 15   | <del>[                                    </del>  | <del>[                                    </del> | 20              | H          | 4        | _        |          | Ŀ   | F            | <u> </u>   | ᠮ—   |              |
|                   | 34.9   | <del>r</del> - | Saure                                 | 20          | 290       | 103  | <del></del>                                       | <del>-</del>                                     | 1 -             | Ħ          | ┪        | _        |          | H   | F            | <del></del>                                      | +  | 0.0          |
| HO1               | 1.35   | 0              | SMAX                                  |             | 62        | 103  | ╄—  | <del> </del>                                     | 120             | H          | 4        | -        |          | <u> </u>  | <u> </u>     | <u> </u>   | _  | 0.0          |
|                   | 34.9   | ř              | i Simi, Σ                             | _           | _         | <del></del>  | ╄╼╾   | <del>-</del>                                     | ₩               | H          | 4        | _        |          | ▙   | Ι            | -  |  | 0.0          |
| Po.               | _  | <u> </u>       | CNAV                                  | 20          | 427       | <del>                                     </del>   | <del>-</del>                                      | <del>-</del>                                     | 11              | H          | 4        | _        |          | Ŀ   | _            | <u> </u>   |  | 0.0          |
| H01               | <0.50  | 0              | ŞMAX                                  |             | 65        | <del>†                                      </del> | +   | <del>-</del>                                     | ╬               | Ħ          | 4        | _        |          | <u>;                                    </u>      | ▙            | <u> </u>   | -  | 0.0          |
| 10.0              | <12.7  | ļ.,            |                                       | 20          | 448       | <u> </u>   | <u> </u>  | <u> </u>   | <u> </u>        | 肆          | ╧        | -        |          | Ŀ   | <u> </u>     | <u> </u>   | <u> </u>   | 0.0          |
| H02               | < 0.50                                       | b -            | SMAX                                  | _           | 80        | <del>-</del>                                       | ╄   | <u> </u>   | ╁╁              | H          | 4        |          |          | ▙   | -            | -  | +  | 0.0          |
|                   | ×12.7  | <u> </u>       |                                       | 20          | 552       | <u> </u>   | <u> </u>  | <u> </u>   | <u> </u>        | H          | _        | -        |          | Ł   | -            | ŀ  | -  | 0.0          |
| Flat Pro<br>OS070 |  | h              | TO/D                                  | lan.        | 140       | 10.4   | <del>-</del>                                      | <del>, _</del>                                   | Ta a I          | -          | 1        | _        |          | ,   | _            |  |  |              |
| OSUIU             |  | b              | ΤΥP                                   | 88          | 46        | 14   | ╪   | <del> </del>                                     | 85              | _          | 58       |          |          | ▙   | <u> </u>     | 32   | +  | 0.0          |
| h                 | <u>                                     </u> | ┸              | Ц_                                    | 20          | 317       | 97   | ┸   | <u> </u>   | 85-             | Ŀţ         | 58       | 15       |          | Ŀ.  | Ŀ,           | 221  | <u>+                                     </u>    | 0.0          |
| Rod<br>H02        | 1.375  | б              | SMIN                                  | es.         | 82        | 20   | T   | _  | 15              | 11         | _        |          |          | <b>-</b>  | _            | 1  | <del></del>                                      | lo o         |
|                   | 34.9   | <del>-</del> - | CIVILITY<br>T                         | 20          | 427       | 138  | <del></del>                                       | <del></del>                                      | -               | H          | +        | -        |          | H   | -            | <del></del>                                      | +  | 0.0          |
| H02               | 0.75   | 0              | SMAX                                  | _           | 70        | 1.30   | <del></del>                                       | <del></del>                                      | 15              | H          | 4        | •        |          | L   | <u> </u>     | <u> </u>   | ‡  | 0.0          |
| 102               | 19.1   | ۴              | NINITA                                | 1           | 1         | <del>-</del>                                       | <del></del>                                       | f  | ╀┼              | H          | 4        | •        |          | F   | <b>!</b>     | <del> </del>                                     | ╪  | 0.0          |
| HA4               |  | ┖              | CLASS                                 | 50          | 463       | 20   | <del>                                     </del>  | <del></del>                                      | 1.1             | ţţ         | _}       | _        |          | <u> </u>  | <u> </u>     |  | 1  | 0.0          |
| H01               | 0.75   | 0              | SMIN                                  | _           | 50        | 20   | +   | <del>-</del>                                     | 15-             | Ħ          | 4        |          | <b>—</b> | ŧ-  | <u> </u>     | <u> </u>   | ╪┷╌  | 0.0          |
| H02               | 19,1<br>0.75                                 | <u>_</u>       | 01.77                                 | 20          | 345<br>55 | 138  | ╀   | <u>‡                                    </u>     | 15              | <b>‡</b> ‡ | 4        |          |          | <u> </u>  | <u> </u>     | <u> </u>   | <u>-t</u>  | 0.0          |
| 102               |  | P              | SMIN                                  | _           | _         | KD.  | <del> </del>                                      | <del> </del>                                     | nu-             | H          | 4        | _        |          | L   | ⊨            | <u> </u>   | +  | 0.0          |
| F1 - 1 - 5        | 19.1   | Ц_             | <u> </u>                              | 20          | 378       | 172  | <u> </u>  | <u> </u>   | 10              | 且          | ┵        |          | <u> </u> | Ł.  | <u>L</u>     | <u> </u>   | 上  | 0.0          |
| Flat Pro<br>OS050 |  | b              | ΗVP                                   | le o        | 42        | lie  | T   | 7  | lo e l          | _          |          |          |          |   |              |  |  |              |
| 79030             | 1  | ۳              | TYP                                   | 68<br>30    | 47        | 15   | ╄   | <del>!                                    </del> | 62              |            |          |          |          | F   | <b> </b>     | <u> </u>   | ╄—   | 0.0          |
| ا مرا             | <u>l'</u>                                    | <u> </u>       |                                       | 20          | 324       | 103  | <u> </u>  | <u>t</u>   | 82              | H          | 4        | 26       | <u> </u> | ᆫ   | _            | <u> </u>   | <u> </u>   | 0.0          |
| Rod<br>H02        | 1.375  | b              | SMAX                                  | sa.         | 50        | 1  | 1   | ī  | <del></del>     | П          | _,       |          |          | _   |              | r  | 1  | ha           |
| 104               | 34,6   | ۴              | SIMPA                                 |             |           | <del></del>  | ╀─  | ╊┈   | ╀               | H          | 4        | -        |          | H   | <b>-</b>     | <del>                                     </del> | +  | 0.0          |
| Elst D            |  | <u> </u>       | <u> </u>                              | 20          | 345       | <u> </u>   | <u> </u>  | <u> </u>   | <u>t t</u>      | tt         | <u> </u> | ٠        | <u> </u> | <u> </u>  | <u> </u>     | <u> </u>   | <u> </u>   | 0.0          |
| Flat Pro<br>OS025 |  | Û              | TYP                                   | 68          | Si        | 19   | <del>,                                     </del> | r  | le e l          | T 14       | ,, J.    | 200      |          | _   | ,            | r—   | _  | h a          |
| ~~uz.J            | 1  | f              | , , , , , , , , , , , , , , , , , , , | _           | 352       | 131  | <del>-</del> -                                    | <del>                                     </del> | 55              | -          | 72       | _        |          | F   | F            | ┡  | +  | 0.0          |
| HQ1               |  | Q              | TVP                                   | 20          |           |  | <del> </del>                                      | <u> </u>   | 55              | Ц          |          |          |          | L   | <u> </u>     | <u> </u>   | <u> </u>   | 0.0          |
| 19 1              | 0.04   | <del>^</del> - | TYP                                   | 68          | 54        | 40   | ╄   | <del>-</del>                                     | 4355            |            | -        |          |          | H   | Ľ            | 36   | +  | 0.0          |
|                   | [1   | ı              | ı                                     | 20          | 372       | 276  | t   | F  | 4355            | +          | · I      | 54       | -        | <b>▶</b>  | ŀ            | 248  | ł-   | <b>l</b> 0.0 |

<sup>\*</sup>Fatigue Strength: 100 x 10  $^6$ cycles, unless indicated as [N]X 10 $^6$ .

**Physical Properties** 

|                          | US Customary | Metric |  |
|--------------------------|--------------|--------|--|
| Melting Point - Liquidus | 1700 F       | 927 C  |  |
| Melting Point - Solidus  | 1650 F       | 899 C  |  |

### Copper.org: Resources: Standards & Properties - Properties of Wrought and Cast Copper Alloys Search

| Density                          | 0.306 lb/in <sup>3</sup> at 68 F         | 8.47 gm/cm <sup>3</sup> @ 20 C           |
|----------------------------------|--|--|
| Specific Gravity                 | 8.47                                     | 8.47                                     |
| Electrical Resistivity           | 39.9 ohms-cmil/ft @ 68 F                 | 6.63 microhm-cm @ 20 C                   |
| Electrical Conductivity          | 26 %IACS @ 68 F                          | 0.152 MegaSiemens/cm @ 20 C              |
| Thermal Conductivity             | 67.0 Btu - ft/(hr - ft2-°F)at 68F        | 116.0 W/m · ºK at 20 C                   |
| Coefficient of Thermal Expansion | 11.3 ·10 <sup>-6</sup> per °F (68-572 F) | 20.3 ·10 <sup>-6</sup> per °C (20-300 C) |
| Specific Heat Capacity           | 0.09 Btu/lb/°F at 68 F                   | 377.1 J/kg · °K at 293 K                 |
| Modulas of Elasticity in Tension | 15000 ksi                                | 103400 MPa                               |
| Modulus of Rigidity              | 5600 ksi                                 | 38610 MPa                                |

**Tempers Most Commonly Used** 

| TOTTIPATO MOOT | 701111101111                         |
|----------------|--------------------------------------|
| Flat Products  |                                      |
| BAR, ROLLED    | H02                                  |
| PLATE          | H02                                  |
| STRIP ROLLED   | NH01 H02 H04 OS025 OS035 OS050 OS070 |

| Other   |      |     |
|---------|------|-----|
| RODH01, | H02, | 060 |

Typical Uses
Builders Hardware
Butts, Hinge Brass, Trim, Hardware
Consumer
Watch Backs
Industrial
Screw Machine Products

Start Another Search

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Copper.org: Resources: Standards & Properties - Properties of Wrought and Cast Copper Alloys ... Page 1 of 3



## Copper.com

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### **Search Results**

C34500

Last Updated: Apr 28, 2008

### **Chemical Composition**

(%max., unless shown as range or min.)

|           |           | ů   |         | Zc   |
|-----------|-----------|-----|---------|------|
| Min./Max. | 62.0-65.0 | .15 | 1.5-2.5 | Rem. |
| Nominal   | 63.5      | E.  | 2.0     | 34.5 |

Note: Cu + Sum of Named Elements, 99.6% min.

### **Applicable Specifications**

| Product | Specification  |
|---------|----------------|
| Rod     | ASTM B453      |
|         | SAE J463, J461 |

### **Common Fabrication Processes**

Machining, Roll Threading and Knurling, Turning

**Fabrication Properties** 

| Joining Technique              | Suitability     |
|--------------------------------|-----------------|
| Soldering                      | Excellent       |
| Brazing                        | Good            |
| Oxyacetylene Welding           | Not Recommended |
| Gas Shielded Arc Welding       | Not Recommended |
| Coated Metal Arc Welding       | Not Recommended |
| Spot Weld                      | Not Recommended |
| Seam Weld                      | Not Recommended |
| Butt Weld                      | Fair            |
| Capacity for Being Cold Worked | Fair            |
| Capacity for Being Hot Formed  | Poor            |
| Machinability Rating           | 90              |

Mechanical Properties (measured at room temperature, 68 F (20 C)

| Temper | Section<br>Size | Cold<br>Work | Typ/<br>Min | Temp | Strength |     | Yield<br>Strength<br>(0.2%<br>offset) | Yield<br>Strength<br>(0.05%<br>offset) | EΙ | Ro<br>Ha | ick<br>rdi | well<br>ness |     | Влі<br>Нал | neli<br>rd. | Shear<br>Strength | Fatigue<br>Strength | izod<br>Impact<br>Strength |
|--------|-----------------|--------------|-------------|------|----------|-----|---------------------------------------|--|----|----------|------------|--------------|-----|------------|-------------|-------------------|---------------------|----------------------------|
|        | in.             | ₩            |             | F    | ksi      | ksi | ksi _                                 | ksi                                    | y, | 8        | q.         | 301          | 500 | 500        | 3000        | ksi               | ksi                 | ti-lib                     |
|        |                 |              |             |      |          |     |                                       |  |    |          | П          | T            |     | Г          |             |                   |                     |                            |

http://www.copper.org/resources/properties/db/CDAPropertiesResultServlet.jsp?action=search

6/23/2008

| •            | ma.           | L   |         | c _ | MPa        | MPa      | MРа      | MPa                | 1  | 1    | I  |    |   | l        | Î  | 1            | мРа  | мРа  | þ   |
|--------------|---------------|-----|---------|-----|------------|----------|----------|--------------------|----|------|----|----|---|----------|----|--------------|--|--|-----|
| Rod          |               |     |         |     |            |          |          |                    |    |      |    |    |   |          | _  |              |  |  |     |
| 060          | 1.375         | 0_  | SMAX    | 38  | 1          |          | _}_      |                    | Ŀ  | 4:   | I  | E  |   | <u> </u> | -  | Ł            | F  | <u> </u>   | 0.0 |
|              | 34.9          | 1   |         | 20  | <u>Ŀ</u> _ | ٠        |          | <u> </u>           | _Ł | 45   | ŧ. | ŀ  | - | ļ        | -  | ŀ            | -  | 1  | 0.0 |
| O60          | <0.50         | Þ   | SMIN    | 68  | 46         | 16       |          | E                  | 72 | đ.   | E  | Ŀ  |   |          | 1  | Ł            |  |  | 0.0 |
|              | <12.7         |     |         | 20  | 317        | 110      | -        | -                  | þ  | ٥-   | ŀ  | F  | - | -        | F  | F            | F  | F  | 0.0 |
| HD1          | 1.375         | 9   | SMIN    | 68  | 42         | 15       |          |                    | 2  | C 40 | Ł  | Ē  | - | -        | F  | F            |  |  | 0.0 |
|              | 34.9          |     | _L_     | 20  | 290        | 103      |          | F                  | ₽  | 048  | Т  | F  |   | -        | Ŧ  | F            |  | -  | 0.0 |
| H01          | <0.50         | D   | SMIN    | 68  | 50         | 25       |          |                    | 1  | ol-  | t  | Ħ  |   |          | Ŧ  | F            | <b>†</b>   | •  | 0.0 |
|              | <12,7         | ļ., | ł       | 20  | 345        | 172      | 1        | -                  | 11 | q.   | F  | F  |   |          | 7- | ŀ            | -  | -  | 0.0 |
| 38O          | 1.375         | 0   | SMIN    | 68  | 40         | 15       |          |                    | 34 | đ.   | Ė  | F  | , |          | 1  | F            | 1  | -  | 0.0 |
|              | 34.9          |     | 1 -     | 20  | 276        | 103      | -        | -                  | В  | d-   | F  | F  | - |          | Ŧ  | F            | <u> </u>   | -  | 0.0 |
| H02          | <0.50         | D   | SMIN    | 58  | 112        | 50       |          |                    | 1  | 7 50 | ŧ. | Ħ  |   |          | Ŧ  | F            | Ŀ  | +  | 0.0 |
|              | <12.7         |     |         | 20  | 772        | 344      | 1        | 1                  | t: | 760  | Т  | П  | _ |          | F  | F            | Ţ  | -  | 0.0 |
| H01          | 0.75          | 0   | SMAX    | 88  | 32         | -        |          | -                  | ✝  | 7:   | Ł  | H  |   |          | F  | ┞            | -  | -  | 0.0 |
|              | 19.1          | Г   | Ī       | 20  | 127        | 7        |          | -                  | Ŧ  | 7:   | Г  | FI | _ |          | T  | F            | -  | <del>                                     </del> | 0.0 |
| Q <b>6</b> 0 | 0.75          | 0   | SMAX    | ម៉  | 1          |          |          | <del>.   -  </del> | 丰  | 45   | t  | H  | - |          | ┲  | ⇟            | ╆  | +  | 0.0 |
|              | 19.1          | Ι   |         | 2e  | Ţ          | 1        |          | -                  | Ţ  | 45   | Ţ  | H  | _ |          | Τ. | ŀ            | T  | Ţ  | 0.0 |
| H02          | <0.50         | þ   | SMAX    | 88  | 150        | F        |          | 1                  | +  | ×    | t  | H  | - | _        | ┲  | F            | <del>                                     </del> | +  | 0.0 |
|              | <12.7         | Г   | $T^{-}$ | 50  | 1035       | 1        | $\top$   | 1                  | T  | 90   | 1  | П  |   |          | T  | ŀ            | Ĭ T  | 1  | 0.0 |
| H01          | 1.375         | O   | SMAX    | 68  | 62         |          | <u> </u> |                    | ⇟  | 70   | 1  | H  |   |          | ┰  | ┢            | -  | ╁┈╴  | 0.0 |
|              | 34.9          | П   | T       | 26  | 127        | -        | $\neg$   | T                  | T  | 70   | Т  | П  | _ |          | Τ. | ŀ            | 1  | 1  | 0.0 |
| H01          | <0.50         | 0   | SMAX    | 68  | 95         | Ţ-       |          | _                  | ╪  | t    | t  | Ħ  | _ |          | ╆  | ナー           | <del>                                     </del> | <u> </u>   | 0.0 |
|              | <12.7         |     |         | 20  | 448        | 1        | 7        |                    | Ŧ  | F    | T  | Ħ  | - |          | Ŧ  | F            | -  | 1  | 0.0 |
| H02          | 0.75          | Ď   | SMAX    | 68  | 62         | <b>T</b> | 1        | +                  | ✝  | 76   | †  | H  | _ | -        | ╪  | +            | ╄  | +  | 0.0 |
|              | t <b>9</b> .1 |     |         | 20  | 427        |          | <u> </u> | Ţ                  | Ŧ  | 75   | •  | Ħ  |   |          | Τ. | Į.           | 1  | 1  | 0.0 |
| 102          | 0.75          | 0   | SMIN    | 68  | 50         | 20       | +        | †                  | 1  | 5 55 | _  | H  | _ | _        | ╬  | ╁╴           | ╌  | +  | G.0 |
|              | 19,1          | Γ   |         | 20  | 345        | 138      | <b>—</b> | ॏ                  | _  | 5 5  | •  | Ħ  | - |          | ✝  | ┞            | 1  | 1.   | 0.0 |
| HQ1          | 0.75          | 0   | SMIN    | 68_ | 50         | 20       | +_       | +                  | _  | 55   | _  | H  |   |          | ╆  | ┢            | <del>                                     </del> | +  | 0.0 |
|              | 19,1          |     |         | 20  | 345        | 138      | T-       | $\top$             | _  | 55   | •  | П  |   |          | T  | T            |  |  | 0.0 |
| Q60          | 0.75          | 6   | SMIN    | 68  | 44         | 15       |          | +                  | 7: | -    | ۲  | H  |   |          | ╁  | <del> </del> | 1-   | +-   | 0.0 |
|              | 19.1          | Ī   |         | 20  | 303        | 103      |          | 1                  | 2: | -    | t  | H  | _ |          | 1  | t            | t  | t  | 0.0 |

<sup>\*</sup>Fatigue Strength: 100 x 10 <sup>6</sup>cycles, unless indicated as [N]X 10<sup>6</sup>.

**Physical Properties** 

|                                  | US Customary   | Metric                                   |
|----------------------------------|--|--|
| Melting Point - Liquidus         | 1670 F   | 910 C                                    |
| Melting Point - Solidus          | 1630 F   | 888 C                                    |
| Density                          | 0.306 lb/in <sup>3</sup> at 68 F                     | 8.47 gm/cm <sup>3</sup> @ 20 C           |
| Specific Gravity                 | 8.47   | 8.47                                     |
| Electrical Resistivity           | 39.9 ohms-cmil/ft @ 68 F                             | 6.63 microhm-cm @ 20 C                   |
| Electrical Conductivity          | 26 %IACS @ 68 F                                      | 0.152 MegaSiemens/cm @ 20 C              |
| Thermal Conductivity             | 67.0 Btu - ft/(hr - ft2.ºF)at 68F                    | 116.0 W/m · <sup>o</sup> K at 20 C       |
| Coefficient of Thermal Expansion | 11.3 ·10 <sup>-6</sup> per <sup>o</sup> F (68-572 F) | 20.3 ·10 <sup>-6</sup> per °C (20-300 C) |
| Specific Heat Capacity           | 0.09 Btu/lb/ºF at 68 F                               | 377.1 J/kg ⋅ ºK at 293 K                 |
| Modulas of Elasticity in Tension | 15000 ksi  | 103400 MPa                               |
| Modulus of Rigidity              | 5600 ksi   | 38610 MPa                                |

**Tempers Most Commonly Used** 

Other

RODH01, H02, O60

**Typical Uses** 

Copper.org: Resources: Standards & Properties - Properties of Wrought and Cast Copper Alloys ... Page 3 of 3

Industrial
Valve Stems, Pinions, Adapters, Couplings, Flare Fittings, Gears
Plumbing
Plumbers' Brass Goods, Plumbing Fittings

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## Copperme

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### Search Results

C35300 (High Leaded Brass, 62%)

Last Updated: Apr 28, 2008

### **Chemical Composition**

(%max., unless shown as range or min.)

|           | Cu <sup>(1)</sup> | Fe <sup>(2)</sup> | РЬ      | Zn   |
|-----------|-------------------|-------------------|---------|------|
| Min./Max. | 60.0-63.0         | .15               | 1.5-2.5 | Rem. |
| Nominal   | 61.5              | -                 | 2.0     | 36.5 |

(1) Cu, 61.0% min. for rod.

(2) For flat products, the iron shall be .10% max.

Note: Cu + Sum of Named Elements, 99,5% min.

#### **Applicable Specifications**

| Product | Specification |
|---------|---------------|
| Bar     | ASTM B121     |
|         | ASTM B121     |
| Rod     | ASTM B453     |
| Sheet   | ASTM B121     |
| Strip   | ASTM B121     |

### **Common Fabrication Processes**

Blanking, Machining, Piercing and Punching, Roll Threading and Knurling, Stamping

**Fabrication Properties** 

| rabilication riopethes         |                 |
|--------------------------------|-----------------|
| Joining Technique              | Suitability     |
| Soldering                      | Excellent       |
| Brazing                        | Good            |
| Oxyacetylene Welding           | Not Recommended |
|                                | Not Recommended |
| Coated Metal Arc Welding       | Not Recommended |
| Spot Weld                      | Not Recommended |
| Seam Weld                      | Not Recommended |
| Butt Weld                      | Fair            |
| Capacity for Being Cold Worked | Fair            |
| Capacity for Being Hot Formed  | Poor            |
| Machinability Rating           | 90              |

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|          | L               |              | POI         | .,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | 1111000             | ured at r                                      |                                       |  | _   |          | ٠,  | _         | <u> </u>   | <u>,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,</u> | <u>''</u>   |              |                   |  |                           |
|----------|-----------------|--------------|-------------|---|---------------------|--|---------------------------------------|--|-----|----------|-----|-----------|------------|--|-------------|--------------|-------------------|--|---------------------------|
| Tempei   | Section<br>Size | Cold<br>Work | Typ/<br>Min | Temp                                    | Tensile<br>Strength | Yield<br>Strength<br>(0.5% ext.<br>under load) | Yield<br>Strength<br>(0.2%<br>offset) | Yield<br>Strength<br>(0.05%<br>offset) | ΕI  | Ro<br>Ha | rdi | ove<br>ne | :  <br>23  | Vickens<br>Hard.                             | Brli<br>Has | nell<br>rd.  | Shear<br>Strength | Fatigue<br>Strength                            | tzod<br>Impact<br>Strengt |
|          | ın.             | %            |             | F                                       | къі                 | kai  | ksi                                   | ksi                                    | 16  | В        | П   | F         | 30T        | 500  | <b>500</b>  | 3000         | kşi               | kai  | ft-ID                     |
|          | mm.             |              |             | c                                       | мРа                 | MPa  | MPa                                   | WРа                                    | T   | T        | П   |           | Т          |  |             |              | MPa               | MPa  | J                         |
| Rod      |                 |              |             |   |                     |  | ·                                     | <u> </u>                               |     |          | ч   |           |            |  | _           |              | •                 |  |                           |
| Q60      | <0,50           | ٥            | SMIN        | 88                                      | 46                  | 16   | F                                     | F                                      | 20  | E        | П   | Е         | Ĺ          |  | E           | F            | -                 | F  | 0.0                       |
|          | <12.7           |              | Γ           | 20                                      | 317                 | 110  | F                                     |  | 2:0 | Г        | П   |           |            |  |             | F            | -                 |  | 0,0                       |
| Flat Pro | ducts           |              |             |   |                     | •  |                                       | <u></u>                                |     |          |     |           |            |  |             |              |                   |  |                           |
| HD8      | 0,04            | 0            | TYP         | 68_                                     | 85                  | 62   |                                       | E.                                     | 5   | 87       | Е   |           | 74         | -  |             |              | 45                |  | 0.0                       |
|          | 1               |              |             | 20                                      | 586                 | 427  | ŀ                                     | ŀ                                      | ß   | 87       | H   | -         | 74         | <b>-</b> ]                                   | ŀ           | 1            | 310               | ŀ  | 0,0                       |
| Rod      |                 |              |             |   |                     |  |                                       |  | _   |          |     |           |            |  |             |              |                   |  |                           |
| H01      | 1.375           |              | SMIN        | 68                                      | 42                  | 15   | <u> </u>                              |  | 20  | Ł        | Ц   | Ŀ         | _          | -  | ш           | Ŀ            | <u> </u>          | <u> </u>                                       | 0,0                       |
|          | 34.B            |              | <u>L</u> .  | 20                                      | 290                 | 103  | -                                     | <u> </u>                               | 20  | Ŀ        | Łl  |           |            | ŀ  |             | Ŀ            |                   |  | 0,0                       |
| H01      | <0.50           | 0            | SMIN        | 88                                      | 52                  | 25   | F                                     | <u> </u>                               | 10  | _        | Ц   | Ц         |            |  | Ē           | F            |                   |  | 0.0                       |
|          | <12.7           |              |             | 20                                      | 358                 | 172  | <u> </u>                              | <u> </u>                               | 10  | Ŀ        | L   | Ł         | Ł          | <u>-</u>                                     | Ŀ           | Ŀ            | <u> </u>          | <u> </u>                                       | 0.0                       |
| Q60      | 1.375           | 0            | SMIN        | 68                                      | 40                  | 15   |                                       |  | 30  | Ē        | Ы   |           |            | -  | Е           | E            |                   |  | 0,0                       |
|          | 34.9            |              |             | 20                                      | 276                 | 103  | <u> </u>                              | <u> </u>                               | 30  |          | L   | Ł         | Ł          | <u> </u>                                     | L           | <u> </u>     | <u> </u>          | <u>-                                      </u> | 0.0                       |
| H02      | 1.375           | 0            | TYP         | 68                                      | 58                  | 45   | -                                     | -                                      | 25  | 75       | IJ  | Е         | Ĺ          |  | Ē           | Ł            | -                 |  | 0.0                       |
|          | 34.9            |              | l           | 20_                                     | 400                 | 310  | ŀ                                     | ŀ                                      | 25  | 75       | H   | -         | 4          | ŀ ]  | ŀ           | <u> </u>     | ŀ                 | ŀ  | 0,0                       |
| H02      | <0,50           | Q            | SMIN        | 58                                      | 57                  | 25   | ŀ                                     | -                                      | 7   | ŀ        |     |           | L          | ŧ.   |             | F            |                   |  | 0.0                       |
|          | <12.7           |              | 1           | 20                                      | 393                 | 172  | -                                     | F                                      | 7   | ŀ        | H   | -         | ŀ          | <b>.</b>                                     | -           | F            | ŀ                 | ┞  | 0,0                       |
| 080      | .75             | o .          | SMIN        | 38                                      | 44                  | 15   | -                                     | F                                      | 25  | Ŀ        | E   |           | Į.         |  |             | E            | -                 | F  | 0.0                       |
|          | 19.1            |              |             | 20                                      | 303                 | 103  |                                       | -                                      | 25  | F        | H   | -         | -          | -  | -           | -            | -                 | -  | 0.0                       |
| Flat Pr  | oducts          |              |             |   |                     |  |                                       |  |     |          | _   |           |            |  |             |              |                   |  |                           |
| H04      | 0.64            | 0            | ТҮР         | 58                                      | 74                  | 30   | <u> </u>                              | -                                      | 7   | 30       | П   | Ш         | 69         |  |             | Ŀ            | 43                | <u> </u>                                       | 0.0                       |
|          | 1               | L            |             | 20                                      | 510                 | 414  |                                       | <u> </u>                               | 7   | 80       | łl  | ŀ         | 89         | <b>ŀ</b> ]                                   | ŀ           | Ŀ            | 296               | <u> </u>                                       | 0,0                       |
| H01      | 0.04            | 0            | TYP         | 36                                      | <del>5</del> 4      | 40   | F.,                                   | -                                      | J8  | 55       | Ð   | į         | 54         | ·  | Ļ           | <u> </u>     | 36                | Ŀ  | 0.0                       |
|          | 1               | Ī            | Ī           | 20                                      | 372                 | 276  | -                                     | F                                      | 118 | 55       | łl  | -         | 54         | <b>.</b>                                     | ┞           | ŀ            | 248               | ŀ  | 0.0                       |
| OS035    | 0.04            | 0            | TYP         | 68                                      | 49                  | 17   | -                                     |  | 52  | E        | E   | 58        | 31         | -  | Ш           | Ŀ            | 34                |  | 0.0                       |
|          | 1               |              |             | 20                                      | 338                 | 117  | -                                     | ŀ                                      | 52  | F        | FI  | 58        | 91         |  | -           | -            | 234               | F  | 0.0                       |
| Rod      |                 |              |             | <u> </u>                                |                     |  |                                       |  |     |          |     |           |            |  |             |              |                   |  |                           |
| H02      | .75             | 0            | SMAX        | 5-8                                     | 70                  |  | <u> </u>                              |  | E   | Ŀ        | E   | Г         |            | <u> </u>                                     | Ы           | Ŀ            | -                 |  | 0.0                       |
|          | 19.1            |              |             | 20                                      | 483                 |  | -                                     | ŀ                                      | Ŀ   | Ŀ.       | ŀΙ  | - ]       | Ŀ          | -  | ŀ           | -            | ŀ                 | ŀ  | 0.0                       |
| H02      | <0.50           | 0            | SHAX        | 88                                      | 30                  | <u>L</u>                                       | F                                     | F                                      | E   | E        | Ø   | Е         |            |  |             | E            | <u> </u>          | Ŀ  | 0.0                       |
| L        | ≈12.7           | l            | l           | 50                                      | 552                 | <b>-</b>                                       | ŀ                                     | }                                      | F   | F        | ŀÌ  | $\vdash$  | <b> </b>   | <b>l</b>                                     | ŀ           | F            | ŀ                 | ŀ  | 0.0                       |
| H01      | 1.375           | 0            | SMAX        | 38                                      | 62                  | <u>F</u>                                       | E                                     | F                                      | E   | E        | П   | Ē         | E          | E  | Ŀ           | E            | E                 |  | 0.0                       |
|          | 34,9            |              |             | 20                                      | 427                 | ļ  | F                                     | }                                      | F   | F        | FĪ  | FĪ        | -          | <u> </u>                                     | F           |              |                   | -<br>-   | 0.0                       |
| H01      | <0.50           | 0            | SMAX        | 68                                      | 85                  |  | F.                                    |  | E   | Е        | D   |           | E          |  | E           | E            | F                 |  | 0.0                       |
|          | <12.7           |              |             | 20                                      | 448                 | I  | -                                     | <u> </u>                               | F   | F        | П   | П         | -          | <b>├</b> ̄ ̄                                 | F           | F _          | -                 | ļ <u> </u>                                     | 0.0                       |
| H01      | .75             | D            | SMIN        | 68                                      | 50                  | 20   | <u> </u>                              | E                                      | 15  | E        | Ħ   | E         | Ē          |  | E           | Ŀ            | F                 |  | 0.0                       |
|          | 19,1            |              |             | 20                                      | 345                 | 138  | -                                     | ļ                                      | 16  | F        | П   | F         | -          | F  | Γ           | F            | -                 | ļ  | 0.0                       |
| H01      | 75              | o            | SMAX        | 68                                      | 62                  |  | Ŀ                                     |  | Ė   | Г        | Ħ   | Ħ         |            |  | E           | E_           |                   |  | 0.0                       |
|          | 19.1            |              |             | 20                                      | 427                 |  | -                                     | F                                      | F   | F        | F   |           | -          | ļ  |             | ŀ            |                   | -  | 0.0                       |
| Flat Pr  | oducts          |              |             | <u> </u>                                |                     | <del></del>                                    | -                                     |  | •   |          | ۷   |           |            |  | _           | <del>-</del> |                   |  |                           |
| H02      | 0.04            | b            | TYP         | 68                                      | 51                  | 50   | F.                                    | <u> </u>                               | 20  | 70       | Ū   | ,         | 65         |  | E           | <u> </u>     | 40                | F  | 0,0                       |
|          | 1               |              |             | 20                                      | 421                 | 345  | -                                     | F                                      | 20  | 70       | П   | FĪ        | 65         | -  | -           | F            | 276               |  | 0.0                       |
| Rod      |                 |              |             |   |                     |  |                                       |  |     |          | _   | _         |            |  |             |              |                   |  |                           |
| H02      | .75             | b            | SMIN        | 68                                      | 55                  | 25   | E                                     | F                                      | 10  | E        | Ð   |           |            |  | Ē           | Ŀ            | Ŀ                 |  | 0.0                       |
|          | 19.1            |              |             | 20                                      | 378                 | 172  | <b>├</b>                              | 1                                      | 10  | $\Gamma$ | П   | П         | <b>↓</b> _ | <b>-</b> □                                   | Ļ ¯         | ŀ            | Ļ                 | <u> </u>                                       | 0.0                       |

<sup>\*</sup>Fatigue Strength: 100 x 10  $^6$ cycles, unless indicated as [N]X  $10^6$ .

**Physical Properties** 

|                          | US Customary | Metric |  |
|--------------------------|--------------|--------|--|
| Melting Point - Liquidus | 1670 F       | 910 C  |  |
| Melting Point - Solidus  | 1630 F       | 888 C  |  |

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| Density                          | 0.306 lb/in <sup>3</sup> at 68 F         | 8.47 gm/cm <sup>3</sup> @ 20 C           |
|----------------------------------|--|--|
| Specific Gravity                 | 8.47                                     | 8.47                                     |
| Electrical Resistivity_          | 39.9 ohms-cmil/ft @ 68 F                 | 6.63 microhm-cm @ 20 C                   |
| Electrical Conductivity          |  | 0.152 MegaSiemens/cm @ 20 C              |
| Thermal Conductivity             | 67.0 Btu · ft/(hr · ft2.ºF)at 68F        |  |
| Coefficient of Thermal Expansion | 11.3 ·10 <sup>-6</sup> per °F (68-572 F) | 20.3 ·10 <sup>-8</sup> per °C (20-300 C) |
| Modulas of Elasticity in Tension |  | 103400 MPa                               |
| Modulus of Rigidity              | 5600 ksi                                 | 38610 MPa                                |

**Tempers Most Commonly Used** 

| Flat Products |                                |
|---------------|--------------------------------|
| BAR, ROLLED   | H02, H04                       |
| PLATE         | H02                            |
| SHEET         | O60                            |
| STRIP, ROLLED | H01, H02, H04, H06, O60, OS035 |

| Other   |      |     |
|---------|------|-----|
| RODH01, | H02, | O60 |

### Typical Uses

**Builders Hardware** 

Drawer Handles, Drawer Pulls, Hinges

Consumer

Clock Plates and Nuts, Clock and Watch Parts, Bicycle Spoke Nipples, Key Blanks

Fasteners

Nuts, Screws, Rivets

Industrial

Instrument Backs, Automatic Screw Machine Parts, Valve Stems, Pinions, Flare Fittings, Couplings, Adapters, Bearing Cages, Channel Plate, Wheels, Gears, Ratchets

Other

**Engravers Plate** 

Plumbing

Plumbers Fittings, Pipe Fittings, Faucet Seats, Faucet Stems, Plumbers' Brass Goods

Start Another Search

#### DISCLAIMER:

The values listed above represent reasonable approximations suitable for general engineering use. Due to commercial variations in compositions and to manufacturing limitations, they should not be used for specification purposes. See applicable ASTM International specification references.

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### Copper.ons

1度 数100% 等地震 物体显示的机器 4种资格从的 完善 4.种种等语数

### **Search Results**

C36000 (Free-Cutting Brass)

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           | Cu        | Fe  | Pb      | Zn   |
|-----------|-----------|-----|---------|------|
| Min./Max. | 60.0-63.0 | .35 | 2.5-3.7 | Rem. |
| Nominal   | 61.5      | -   | 3.1     | 35.4 |

Note: Cu + Sum of Named Elements, 99.5% min.

**Applicable Specifications** 

| repphoable openingations |                      |  |  |  |  |  |  |  |
|--------------------------|----------------------|--|--|--|--|--|--|--|
| Product                  | Specification        |  |  |  |  |  |  |  |
| Bar                      | AMS 4610             |  |  |  |  |  |  |  |
|                          | ASTM B16             |  |  |  |  |  |  |  |
|                          | SAE J461, J463       |  |  |  |  |  |  |  |
| Rod                      | AMS 4610             |  |  |  |  |  |  |  |
|                          | ASTM B16             |  |  |  |  |  |  |  |
|                          | SAE J463, J461       |  |  |  |  |  |  |  |
| Shapes                   | ASTM B16             |  |  |  |  |  |  |  |
|                          | SAE J461, J463       |  |  |  |  |  |  |  |
| Valves                   | MILITARY MIL-V-18436 |  |  |  |  |  |  |  |
| Wire                     | ASTM B16             |  |  |  |  |  |  |  |

Common Fabrication Processes
Machining, Roll Threading and Knurling

**Fabrication Properties** 

| Joining Technique              | Suitability     |
|--------------------------------|-----------------|
| Soldering                      | Excellent       |
| Brazing                        | Good            |
| Oxyacetylene Welding           | Not Recommended |
| Gas Shielded Arc Welding       | Not Recommended |
| Coated Metal Arc Welding       | Not Recommended |
| Spot Weld                      | Not Recommended |
| Seam Weld                      | Not Recommended |
| Butt Weld                      | Fair            |
| Capacity for Being Cold Worked | Fair            |
|                                |                 |

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| Capacity for Being Hot Formed | Fair |
|-------------------------------|------|
| Machinability Rating          | 100  |

|            | a i i i ça  |          | pei         | 463      | 1111000   | ured at I                                    |  | Yleki   | Ë    | <del></del> | Ť    | <u>, `</u> | /0       | 120  | ~        |                | г—   |   | ·                 |
|------------|-------------|----------|-------------|----------|---|--|--|---|------|-------------|------|------------|----------|--|----------|----------------|--|---|-------------------|
|            | Section     | Cold     | TVO         | L        | Tensite   | k  | Strength   | Tieks<br>Stranuth                                 | L    | Ro          | ve i | CWI        | 11       | Vickens  | Bris     | neti           | Shear  | Fatigue   | 1200              |
| emper      |             | Work     | Min         | Temp     | Strength  | (0.5% ext.<br>under load)                    | KU.2%  | (0.06%<br>(feet)                                  | Εı   | H           |      |            |          |  | Har      | d.             | Strength   | Strength'   | impact<br>Strengt |
|            | in.         | ¥.       |             | F        | ksi   | ksi  | ksi  | kar   | 7.   | 6           | þ    | F          | 30T      | 500  | 500      | 3000           | ksi  | KSÌ   | H⊣b               |
|            | mm.         |          |             | С        | MPa   | мРа  | MPa  | MPa   |      |             |      |            |          |  |          |                | MPa  | MPa   | þ                 |
| Rod        |             | 6        | TVD.        | 20       |   |  |  |   |      | he          | Т    | _          |          |  | _        | _              | <del></del>                                      |   | 0.0               |
| 102        | 1.5<br>38 1 | -        |             | 68<br>20 | <del></del>                                       | <del></del>                                  | <del>-</del>                                     | <del></del>                                       | F    | 65<br>65    |      | ۲          | H        | <del>-</del>                                     | F        |                | <del>-</del>                                     | <del></del>                                       | 0.0               |
| 204        | 0.375       |          |             |          | ├   |  |  |   | ┡    | -           | -    | H          | H        | <u> </u>   | -        | <del>[</del> — | 34   |   | 0.0               |
| 104        | 12.7        | -        | 111         | 38<br>20 |   | <u> </u>                                     | F  | <del></del>                                       | F    | 76<br>78    | •    | Н          | H        | <del></del>                                      | f        | ┢              | 234  | <del></del>                                       | 0.0               |
| 102        | 0.75        | 0        | MIN         | 58       |   |  | <u> </u>   |   | ┡    | 70          | -    | F          | -        |  | ⊱        | <u> </u>       | 2.54   |   | 0.0               |
| 102        | 19,1        | <u> </u> |             | 20       |   |  |  |   | f    | 70          | -    | Н          | _        | ᡛ  | ┨        | t              | <del></del>                                      |   | 0.0               |
| H04        | 0.625       | 0        | SMIN        |          | 65  | 30   | <del>[                                    </del> | ╌   | 6    | Ľ           | H    | -          | _        |  | ⊱        | [              |  |   | 0.0               |
| 107        | 15.9        | <u> </u> | OWNER       | 20       | 450   | 205  | [  |   | Ĕ    | E           | t    |            |          | _  | t        |                |  |   | 0.0               |
| 102        | 3.0         |          | SMIN        |          | 45  | 15   | ╌  |   | 20   | ₽           | t    | ┝          | ┝        | ├  | ⊢        | ╌              | <del>                                     </del> |   | 0.0               |
|            | 76.2        | <u> </u> | -           | 20       | 310   | 105  | <u> </u>   |   | 20   | •           | H    |            | T        | t.   | L        | _              |  |   | 0.0               |
| 060        | 1.5         | 0        | SMIN        |          | 44  | 18   | <del></del>                                      | -   | 20   | _           | Н    | ۲          | H        |  | _        | -              | -  | <del>-</del>                                      | 0.0               |
|            | 38.1        |          |             | 70       | 305   | 18   |  |   | 20   | •           | Г    | Г          | F        | Ι-   | F        | _              | 1  | Ι   | 0.0               |
| H02        | <0.50       | 0        | ТҮР         | 68       | <del></del>                                       | <del></del>                                  | <u> </u>   | <del></del>                                       | ۲    | 65          | F    | ۲          | F        | <del>├</del> ┈─                                  | ļ.       | ┡              | 32   | 20  | 0.0               |
|            | 12.7        |          |             | 20       | F   | -  | Ι  | ļ.  | F    | 65          | -    | Г          | F        | -  | F        | F              | 221  | 138   | 0.0               |
| 9ar        | _           |          |             | 1        | <u> </u>  |  |  | -   | _    | _           | _    | _          |          |  | <u> </u> |                | I  | •   |                   |
| H02        | <0.50       | G        | SMIN        | 68       | 50  | 25   | ŀ  | F   | ic   | ŀ           | ŀ    | Ŀ.,        |          | F  | E        | F              | -  | -   | 0,0               |
|            | <12.7       |          |             | 50       | 345   | 170  | -  | }   | 10   | 1           | F    | F          | F        | -  | ŀ        | -              | F  | ŀ   | 0.0               |
| 060        | 1.5         | 0        | SMIN        | 68       | 40  | 15   | ŀ  | ŀ   | 25   | Ł           | E    |            |          | F  | E        | -              | -  | <u> </u>  | 0.0               |
|            | 38.1        |          | _           | 20       | 275   | 105  | ŀ  | -   | 25   | ŀ           | ŀ    | ŀ          | ŀ        | ŀ  | ŀ        | ┡              | ŀ  | ŀ   | 0.0               |
| Shapas     |             |          |             |          | · .   |  |  |   |      |             | Ξ    |            |          |  |          |                |  |   |                   |
| H01        | 0.5         | 11       | TYP         | 68       | 56  | 45   | <u> </u>   | <u> </u>  | -    | 62          | -    | <u> </u>   | ▙        | <u> </u>   | Ł        | ▙              | 33   |   | 0.0               |
|            | 12.7        |          | <u> </u>    | 20       | 386   | 310  | <u> </u>   | <u> </u>  |      | 62          | Ł    | Ŀ          | <u> </u> | <u> </u>   | Ł        | <u> </u>       | 228  |   | 0.0               |
| M30        | 0.5         | 0        | TΥΡ         | 68       | 49  | 18   | ⇇──  | <u> </u>  | þQ   | _           | Ł    | 38         | <u> </u> | <u> </u>   | Ł        | <u> </u>       | 30   | <u> </u>  | 0.0               |
|            | 12.7        | L        |             | 20       | 338   | 124  | <u> </u>   | <u> </u>  | 50   | <u>Ł</u>    | Ł    | 68         | 乚        | <u>t.                                    </u>    | Ł_       | <u> </u>       | 207  | <u> </u>  | 0.0               |
| Rod        | 6.6         | 6        | Cosain      | L. n     | le o  | Lin.   |  |   | T. / | <u> </u>    | _    | ,          | _        |  | _        |                |  | r -   | h o               |
| H02        | 1.5         | <u> </u> | SMIN        | _        | 50  | 20   | <del> </del>                                     | <del></del>                                       | 15   | -           | ŀ    | Ŀ          | H        | <del>-</del>                                     | F        | <u> </u>       | •  | <del>-</del>                                      | 0.0               |
| 040        | 38,1        | _        | 63711       | 20       | 345   | 140  | <del> </del>                                     | <u> </u>  | 15   |             | ŀ    | Ŀ          | <u> </u> | <u> </u>   | Ŀ        | ļ              | <u> </u>   | <del>-</del>                                      | 0.0               |
| 060        | <1<br>-05 4 | 0        | SMIN        |          | 48<br>330   | 20<br>124                                    | <del>-</del>                                     | <del> </del>                                      | 15   | 7           | H    | ŀ          | H        | <del>-</del> -                                   | F        | <del> </del>   | <del></del>                                      |   | 0.0<br>0.0        |
|            | <25.4       | L        | <u> </u>    | 50       | p30   | 124  | <u> </u>   | <u> </u>  | 15   | L           | L    | Ľ          | <u> </u> | <u> </u>   | <u> </u> | <u> </u>       | Ĭ  | <u> </u>  | D.U               |
| Bar<br>H02 | 1.5         | 6        | TYP         | 88       | l   | L .  | T.   | 1.  | L    | 60          | L    |            |          | L  | Г        | 1              | Į.   | <u> </u>  | 0.0               |
|            | 38.1        | <u> </u> | <del></del> | 20       | <u> </u>  |  |  | 1   | t    | so          | -    | t          | H        |  | t        | ┖              |  | <u> </u>  | 0.0               |
| HD2        | <0.50       | 0        | TYP         | 68       | ╁   | <u>.                                    </u> | <del></del>                                      | <del>                                     </del>  | t    | 35          |      | t          | H        | l  | H        | ╌              | <del></del>                                      |   | 0.0               |
|            | <12.7       | <u> </u> | · · ·       | 20       | <del>.                                     </del> |  | <u> </u>   |   | t    | 85          | •    |            | ļ —      |  |          | !-             |  |   | 0.0               |
| Rod        | 1           | Ц        | <u> </u>    | <u> </u> |   | <u>t                                    </u> | <u> </u>   |   | _    | <u>- ·</u>  | _    |            |          | <u> </u>   | <u> </u> | _              | 1  | L   | 1-7-              |
| H02        | 4.5         | 0        | SMIN        | 38       | 40  | 15   | ŀ  | Ŀ.  | 20   | 25          | Ł    | F          | ·        | ŀ  | -        | ŀ              | F  | -   | 0.0               |
|            | 114.3       |          |             | 20       | 275   | 105  | F  | <u> </u>  | 20   | 25          | F    | F          | F        |  | F        | F              | F  | F   | 0.0               |
| H04        | 0.25        | c        | TYP         | 68       | Ē   | E  | F  | <u> </u>  |      | 30          | ŀ    | E          | E        | E  | E        | F _            | 38   | F   | 0.0               |
|            | 6,35        |          |             | 20       | 1   | F  | 1  | F   |      | 30          |      |            | F        | <u> </u>   | F        | -              | 262  | <u> </u>  | 0.0               |
| Flat Pro   | ducts       |          |             |          |   |  |  |   |      | _           |      | _          | _        |  |          |                |  |   |                   |
| H02        | 0.25        | 11       | TΥP         | 58       | 56  | 45   | -  | <u> </u>  |      | 62          |      |            | Ł.       | ·  | E        |                | 33   | <u> </u>  | 0.0               |
|            | 4.76        | <u> </u> |             | 20       | 386   | 310  | <u> </u>   | <u> </u>  | 20   | <b>l</b> 02 | Ł    | Ŀ          | Ŀ        | <u> </u>   | Ł        | Ł              | 228  | <u> </u>  | 0,0               |
| Rod        | le 455      |          | la com      |          | L .   | E  |  |   |      | Ţ           | Ē    | F          |          |  | F        | _              |  |   |                   |
| 104        |             | ٥        | SMIN        |          | 70  | 35   | キ—   | <del> </del>                                      | Ł    | -           | Ł    | È          | i—       | <del>                                     </del> | ╄        | ţ              | <del></del>                                      | <del>                                      </del> | 0.0               |
|            | 12.7        |          |             | 20       | 180   | 240  | <u> </u>   | Ļ   | Ľ.   | -           | L    | L          | <u> </u> | <u> </u>   | 上        | ļ              | <u> </u>   | <u> </u>  | 0.0               |
| H02        | 0.75        | 0        | SMIN        |          | 55  | 25   | <del> </del>                                     | <del>                                     </del>  | 10   | •           | Ł    | _          | Ŀ        | <del> </del>                                     | Ŀ        | -              | 34   | <del></del>                                       | 0.0               |
|            | 19.1        | <u> </u> | <u> </u>    | 20       | 380   | 175  | <u> </u>   | <u> </u>  | 10   | _           | Ŀ    | Ŀ          | ㄴ        | <u> </u>   | 上        | <u> </u>       | 234  | <u> </u>  | 0.0               |
| H02        | 3.0         | b        | TYP         | 38       | <del> </del>                                      | <del> </del>                                 | <u> </u>   | <del>                                      </del> | Ł    | 55          | •    | F          | <b>!</b> | <u> </u>   | Ł        | <u> </u>       | <del> </del>                                     | <del> </del>                                      | 0,0               |
|            | 76.2        |          |             | 20       | L   | L  | L  | L   |      | 55          |      |            |          | L  | •        |                | L  | Ł   | 0.0               |

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| O60  | <b>K1</b> | þ   | SMIN | 68 | 44  | 18  |              |   | 120 | H  | ŀŀ  | -  - | ŀ        | ı      |   | ŀ   | ļ.  | ŀ  | 0.0 |
|------|-----------|-----|------|----|-----|-----|--------------|---|-----|----|-----|------|----------|--------|---|-----|-----|----|-----|
|      | <25.4     |     |      | 50 | 305 | 125 | 1            | _ | 20  | Г  | - ] | Ŧ    | <u> </u> | Ţ      |   | F   | 1   | Ţ. | 0.0 |
| Rod  |           |     |      |    |     |     | <del>^</del> |   |     | ч  | _   |      |          |        | - | _   | -   |    |     |
| Q60  | <1        | р   | TYP  | 68 | Ŀ   |     | F            |   | ŀ   | 28 | ·   |      | ÷        |        |   | F   | 30  | ·  | 0.0 |
|      | <25.4     | Ι   |      | 20 | 1   | - I | 1 T          |   | F   | 28 | F   |      | Τ-       |        |   | F   | 207 | -  | 0.0 |
| H04  | 0.25      | þ   | SMIN | 68 | 80  | 45  | F            |   |     | П  | -   | Œ    | 1        |        | _ | F   | 1   | 1  | 0.0 |
|      | 6.35      |     |      | 20 | 550 | 310 | T-           |   | F   | П  | - [ | Ŧ    | F        | Ţ      |   | Γ   | F   | Ŧ  | 0.0 |
| O80  | 2.5       | D   | SMIN | 68 | 40  | 15_ |              |   | 25  |    | Ħ   | Ŧ    | 1        |        |   |     | ļ — | +  | 0.0 |
|      | 53.5      | Г   |      | 20 | 40  | 15  | Ţ.           | _ | 25  | П  | П   | Ŧ    | Ţ        |        |   | 1   | 1   | Ţ. | 0.0 |
| H02  | <0.50     | þ T | TYP  | 68 | 57  | 25  |              |   | 7   | Ħ  | Ħ   | ✝    | ╪        | _      |   | ┞   | +   | ┮  | 0.0 |
|      | 12.7      |     | Т    | 20 | 395 | 170 | Ţ            |   | 7   | П  | 7   | Ť    | T        | $\neg$ |   | Г   | 1   | 7  | 0.0 |
| Bar  |           | •   |      |    |     |     | <u> </u>     | _ |     | ш  | _   |      |          |        | _ |     | •   |    |     |
| :102 | 3         | 0   | SMIN | 68 | 40  | 15  | ]-           |   | 20  | Ë  | Ð   | Ē    | F        | }      |   | ŀ _ | J   | F  | 0.0 |
|      | 76.2      |     |      | 20 | 275 | 105 | 1            |   | 20  | -  | -   | Ŧ    | 1        | - 1    |   | -   | Ţ   | 1  | 0.0 |
| H02  | 1.5       | 0   | SMIN | 68 | 45  | 17  |              |   | 15  |    |     | Ŧ    | F        |        |   | F   | -   | ŀ  | 0.0 |
|      | 38.1      |     |      | 20 | 310 | 115 | $\top$       |   | 15  | П  | Π.  | T    | F        |        |   | F   | Ţ.  | T  | 0.0 |
| O60  | 1.5       | 0   | TYP  | 60 | Ŧ   | Ţ   | 1            |   | +   | 22 | Ħ   | ╈    | +-       |        | _ | ┢   | ㅑ   | ╁┈ | 0.0 |
|      | 38.1      |     |      | 20 | Ţ   | T - | Ţ.           |   | Т   | 22 | ī   | T    | L        |        |   |     | 1   | 1  | 0,0 |

<sup>\*</sup>Fatigue Strength: 100 x 10 <sup>6</sup>cycles, unless indicated as [N]X 10<sup>6</sup>.

**Physical Properties** 

|                                  | US Customary   | Metric   |
|----------------------------------|--|--|
| Melting Point - Liquidus         | 1650 F   | 899 C  |
| Melting Point - Solidus          | 1630 F   | 888 C  |
| Density                          | 0.307 lb/in <sup>3</sup> at 68 F                     | 8.5 gm/cm <sup>3</sup> @ 20 C                        |
| Specific Gravity                 | 8.5  | 8.5  |
| Electrical Resistivity           | 39.9 ohms-cmil/ft @ 68 F                             | 6.63 microhm-cm @ 20 C                               |
| Electrical Conductivity          |  | 0.152 MegaSiemens/cm @ 20 C                          |
| Thermal Conductivity             | 67.0 Btu - ft/(hr - ft2-ºF)at 68F                    | 116.0 W/m · ºK at 20 C                               |
| Coefficient of Thermal Expansion | 11.4 ·10 <sup>-6</sup> per <sup>o</sup> F (68-572 F) | 20.5 ·10 <sup>-6</sup> per <sup>o</sup> C (20-300 C) |
| Specific Heat Capacity           | 0.09 Btu/lb/°F at 68 F                               | 377.1 J/kg ⋅ ºK at 293 K                             |
| Modulas of Elasticity in Tension |  | 96500 MPa  |
| Modulus of Rigidity              | 5300 ksi   | 36500 MPa  |

### **Tempers Most Commonly Used**

|     | Products |      |     |
|-----|----------|------|-----|
| BAR | , DRAWN  | H01, | H02 |

| Other  |      |     |
|--------|------|-----|
| ROD    | H02, | O60 |
| SHAPES | HQ1, | H02 |

Typical Uses Architecture Terrazzo Strip

Automotive

Sensor Bodies, Thermostat Parts, Fluid Connectors, Threaded Inserts for Plastic

**Builders Hardware** 

Lock Bodies, Fittings, Hardware

Consumer

Hot Combs (to Straighten Hair)

**Fasteners** 

http://www.copper.org/resources/properties/db/CDAPropertiesResultServlet.jsp?action=search

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Screws, Nuts, Bolts

Industrial

Faucet Components, Pinions, Automatic Screw Machine Parts, Pneumatic Fittings, Gears, Nozzles, Valve Stems, Valve Trim, Valve Seats, Gauges, Fluid Connectors, Screw Machine Products, Adapters, Unions Plumbing

Faucet Stems, Plumbers' Brass Goods, Faucet Seats, Plumbing Fittings

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## Copperies

### **Search Results**

C37700 (Forging Brass)

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           | Cu        | Fe  | Pb      | Zn   |
|-----------|-----------|-----|---------|------|
| Min./Max. | 58.0-61.0 | .30 | 1.5-2.5 | Rem. |
| Nominal   | 59.5      |     | 2.0     | 38.0 |

Note: Cu + Sum of Named Elements, 99.5% min.

**Applicable Specifications** 

| Product         | Specification_  |
|-----------------|---|
| Bar, Forging    | ASTM B124   |
| Forgings, Die   | AMS 4614<br>ASME SB283<br>ASTM B283<br>SAE J461, J463 |
| Rod, Forging    | AMS 4614<br>ASTM B124                                 |
| Shapes, Forging | ASTM B124   |

### **Common Fabrication Processes**

Hot Forging and Pressing, Hot heading and upsetting, Machining

**Fabrication Properties** 

| Suitability     |
|-----------------|
| Excellent       |
| Good            |
| Not Recommended |
| Not Recommended |
| Not Recommended |
| Not Recommended |
| Not Recommended |
| Fair            |
| Poor            |
| Excellent       |
| 100             |
|                 |

http://www.copper.org/resources/properties/db/CDAPropertiesResultServlet.jsp?action=search

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| Machinability Rating | 80 |
|----------------------|----|
|----------------------|----|

Mechanical Properties (measured at room temperature, 68 F (20 C)

| Temper | Section<br>Size | Cold<br>Wark | Typ/<br>Min | Temp   | Tensils<br>Strength |     | Strength<br>(0.2% | Yleid<br>Strength<br>(9.06%<br>offset) | E  | Ro<br>Hi | ock: | MP()<br>teda | Vickens<br>Hard. | Brir<br>Han | n <del>e</del> ll<br>d. | Shear<br>Strength |     | izod<br>impact<br>Strength |
|--------|-----------------|--------------|-------------|--------|---------------------|-----|-------------------|--|----|----------|------|--------------|------------------|-------------|-------------------------|-------------------|-----|----------------------------|
|        | in.             | 76           |             | ۴      | ksi .               | ksi | kşi               | \si                                    | %  | В        | CF   | 301          | 500              | 500         | 3000                    | ksi               | ksi | H-ID                       |
|        | mm.             |              |             | υ<br>U | MPs                 | MРа | мРа               | MPe                                    | Γ  | П        | Т    | П            |                  |             |                         | MPa               | MPa | j                          |
| Shapes |                 |              |             |        |                     |     |                   |  |    |          |      |              | •                |             |                         |                   | _   |                            |
| M30    | 1               | 0            | TYP         | 68     | 52                  | 20  | -                 |  | 4. | Ħ        | 7    | 3 <b>-</b>   |                  |             | -                       |                   | -   | 0.0                        |
|        | 25.4            |              |             | 20     | 359                 | 138 |                   |  | 45 | П        | . 72 | <u>.</u>     | -                |             |                         |                   |     | 0.0                        |
| Rod    |                 |              |             |        |                     |     |                   |  |    |          | -    |              |                  |             |                         |                   | ·   | <u> </u>                   |
| M30    | t               | 0            | TYP         | 68     | 52                  | 20  |                   |  | 45 | IJ       | - 76 | <u> </u>     | L.               |             | -                       | F                 |     | 0.0                        |
|        | 25.4            |              |             | 20     | 359                 | 138 |                   | -                                      | 45 | H        | . 71 | <b>.</b>     |                  |             |                         |                   |     | 0.0                        |

<sup>\*</sup>Fatigue Strength: 100 x 10 <sup>6</sup>cycles, unless indicated as [N]X 10<sup>6</sup>.

**Physical Properties** 

|                                  | US Customary   | Metric                                   |
|----------------------------------|--|--|
| Melting Point - Liquidus         | 1640 F   | 893 C                                    |
| Melting Point - Solidus          | 1620 F   | 882 C                                    |
| Density                          | 0.305 lb/in <sup>3</sup> at 68 F                     | 8.44 gm/cm <sup>3</sup> @ 20 C           |
| Specific Gravity                 | 8.44   | 8.44                                     |
| Electrical Resistivity           | 38.4 ohms-cmil/ft @ 68 F                             | 6.38 microhm-cm @ 20 C                   |
| Electrical Conductivity          | 27 %IACS @ 68 F                                      | 0.158 MegaSiemens/cm @ 20 C              |
| Thermal Conductivity             | 69.0 Btu · ft/(hr · ft2·°F)at 68F                    | 119.4 W/m · °K at 20 C                   |
| Coefficient of Thermal Expansion | 11.5 ·10 <sup>-6</sup> per <sup>o</sup> F (68-572 F) | 20.7 ·10 <sup>-6</sup> per °C (20-300 C) |
| Specific Heat Capacity           | 0.09 Btu/lb/ºF at 68 F                               | 377.1 J/kg · °K at 293 K                 |
| Modulas of Elasticity in Tension | 15000 ksi  | 103400 MPa                               |
| Modulus of Rigidity              | 5600 ksi   | 38610 MPa                                |

### **Tempers Most Commonly Used**

| Flat Products |      |     |
|---------------|------|-----|
| BAR, DRAWN    | H02, | M20 |
| BAR, ROLLED   | H02, | M20 |

| Other  |     |      |     |
|--------|-----|------|-----|
|        |     | M20, | M30 |
| SHAPES | M30 |      |     |

### Typical Uses Builders Hardware

Door Handles, Decorative Knobs, Furniture Hardware

Building

Valve Bodies for Refrigeration, Chemicals

Consume

Golf Putters, Valve Bodies for Scuba & Propane Spray Tanks, Valve Bodies for Agricultural Spray Tanks

**Electrical** 

Covers, Fuse Bodies

Industrial

Valve Components, Forgings and Pressings of All Kinds

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## Copperant

<u>表面和异物色线 的性素精性的能力 有种结构 等多类特种 等外流</u>

### **Search Results**

C41100 (Tin Brass)

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           |           |    | Рb       |      | Zn   |
|-----------|-----------|----|----------|------|------|
| Min./Max. | 89.0-92.0 | 05 | .09      | .307 | Rem. |
| Nominal   | 91.0      | ,  | <b>.</b> | .50  | 8.5  |

Note: Cu + Sum of Named Elements, 99.7% min.

**Applicable Specifications** 

| Product               | Specification        |
|-----------------------|----------------------|
| Bar, Rolled           | ASTM B591            |
| Bearings and Bushings | MILITARY MIL-B-13501 |
| Bushing Stock         | MILITARY MIL-B-13501 |
| Plate                 | ASTM B591            |
| Sheet                 | ASTM B591            |
| Strip                 | ASTM B591            |
| Strip, Flexible Hose  | ASTM B508            |
| Wire                  | ASTM B105            |

### **Common Fabrication Processes**

Blanking, Drawing, Forming and Bending, Piercing and Punching, Shearing, Spinning, Stamping

**Fabrication Properties** 

| rabilication Froperties               |                 |
|---------------------------------------|-----------------|
| Joining Technique                     | Suitability     |
| Soldering                             | Excellent       |
| Brazing                               | Excellent       |
| Oxyacetylene Welding                  | Fair            |
| Gas Shielded Arc Welding              | Good            |
| Coated Metal Arc Welding              | Not Recommended |
| Spot Weld                             | Fair            |
| Seam Weld                             | Not Recommended |
| Butt Weld                             | Good            |
| Capacity for Being Cold Worked        | Excellent       |
| Capacity for Being Hot Formed         | Good            |
| · · · · · · · · · · · · · · · · · · · |                 |

Machinability Rating

| . and the | Section<br>Size<br>in. | Cold<br>Work | Min  | Temp | Tensile<br>Strength | Yield<br>Strength<br>(0.5% ext.<br>under load)<br>ksi | offset) | Yield<br>Strength<br>(0,06%<br>offset)<br>ksi | ũ        | Rockwell<br>Hardness |      |             | Vickens<br>Hard, | Brinell<br>Hard, |          | Shear<br>Strength | Fatigua<br>Strength | izod<br>Impact<br>Strengti |       |
|-----------|------------------------|--------------|------|------|---------------------|---|---------|---|----------|----------------------|------|-------------|------------------|------------------|----------|-------------------|---------------------|----------------------------|-------|
|           |                        |              |      |      |                     |   |         |   | 7.       | В                    | C.   | 30          | П                | 500              | 500      | 3000              | ksi                 | ksi                        | ft-lb |
|           | mm.                    |              |      | c    | MPa                 | MPa   | MPa     | MPa   | Г        | Г                    | T    | T           | T                |                  |          |                   | MPa                 | MPa                        | Ú     |
| Flat Pro  | ducts                  |              |      |      | <u> </u>            | <del></del>   | •       |   | ۲.       |                      | _    |             |                  |                  |          | •                 | <b>!</b>            | l                          | I .   |
| OS015     | 0.04                   | 0            | TYP  | 68   | 42                  | 12  | 15      |   | 40       | Ē                    | - 6  | 8 3         | 2]               |                  | F        | ŀ                 | 34                  |                            | 0.0   |
| -         | 1                      |              |      | 20   | 290                 | 83  | 103     | -   | 40       | Г                    | - 6  | 933         | 3                | -                |          |                   | 234                 |                            | 0.0   |
| i02       | 0.04                   | D            | TΥP  | 68   | 55                  | 47  | 53      | -   | 14       | 61                   | #    | 52          | 7                |                  |          | _                 | 38                  |                            | 0.0   |
|           | 1                      |              |      | 20   | 379                 | 324   | 365     |   | 14       | 81                   | Ţ    | 58          | ,                | -                |          |                   | 248                 |                            | 0.0   |
| H06       | 0.04                   | 0            | TYP  | 68   | 72                  | 60  | 70      |   | •        | 70                   | #    | 65          | ,                | -                | ┢        | H                 |                     |                            | 0.0   |
|           | 3                      |              |      | 20   | 496                 | 414   | 483     |   | L        | 79                   | T    | 69          | -                |                  |          | L                 |                     |                            | 0.0   |
| H03       | 0.04                   | 0            | TYP  | 68   | 50                  | 52  | 58      |   |          | 70                   | +    | 6/          | _                |                  | L-       |                   |                     |                            | 0.0   |
|           | 1                      |              | _    | 20   |                     | 359   | 400     | _   | 6        | 70                   | -    | 84          | -                |                  | _        |                   |                     |                            | 0.0   |
| OS035     | 0.04                   | 0            | ΤΥΡ  |      | 39                  | 11  | 12      |   | 43       |                      |      | <u>52</u> 1 |                  |                  | Н        |                   | 33                  | -                          | 0.0   |
|           | 1                      |              |      | 20   | 269                 |   | 83      |   | 43       | Н                    | -    | 021         | -                | _                | H        |                   | 228                 |                            | 0.0   |
| 104       | 0.04                   |              | TÝP  |      |                     | 55  | 64      |   | 5        | -                    | H    | 67          | _                |                  | Н        |                   | 40                  |                            | 0.0   |
|           | 1                      |              | -    | 20   |                     | 379   | 441     |   | 5        | 7=                   | t    | 67          | -                |                  | $\vdash$ |                   | 276                 |                            | 0.0   |
| Vire      | <u> </u>               |              | Ь.   |      | ļ. <b>-</b> -       | <u> </u>  |         |   | <u> </u> | רא                   |      | ν.          | _                |                  | _        |                   | <u></u>             |                            | ٧.٧   |
|           | 0.1                    | 95           | TYP  | 68   | 102                 |   | _       |   | ī        |                      | T    | T           | ٦                |                  | _        |                   |                     |                            | 0.0   |
|           | 2.54                   |              | _    | 20   | 703                 |   |         |   | ì        | П                    | ,    | 1           | T                |                  |          |                   |                     | -                          | 0.0   |
| Flat Pro  | ducts                  | لسا          |      | ·    |                     |   |         |   | H        | L                    |      | _           | _                |                  | _        | Ц.                |                     |                            | F     |
| H08       | 0.04                   | 0            | ΪΫ́Р | 68   | 78                  | 70  | 75      |   | 3        | <b>B</b> 2           | Ŧ    | 71          | Т                | -                | <u> </u> | -                 | _                   | -                          | 0.0   |
|           | 1                      |              |      | 20   | 538                 | 483   | 517     |   | 3        | B2                   | 7.   | 71          | Ţ                | ,                | L.       |                   | _                   |                            | 0.0   |
| Wire      |                        |              |      |      |                     |   |         |   |          |                      | _    | _           | _                |                  | -        |                   |                     | L                          |       |
| H04       | 0.25                   | 70           | TYP  | 68   | B1 :                |   |         |   | 2        | -                    | -  - | F           | Ţ                |                  | -        | -                 | -                   | -                          | 0.0   |
|           | 6.35                   |              |      | 20   | 558                 | - "   |         |   | 2        | Į.                   |      | F           | Ţ                |                  |          |                   | -                   | -                          | 0.0   |
| H04       | 0.05                   | 98           | TYP  | 88   | 106                 |   |         |   | Đ        | H                    | †    | ╆           | 7                |                  | _        |                   | -                   |                            | 0.0   |
|           | 1.27                   |              |      | 20   | 731                 | -   |         |   | 9        | П                    | .T.  | F           | T                |                  | ١.,      | _                 |                     |                            | 0.0   |
| Flat Pro  | ducts                  |              |      |      |                     | <u> </u>  |         |   | -        | ш                    | _    |             |                  |                  |          |                   |                     |                            |       |
| DS025     | 0.04                   | <b>0</b>     | TYP  | 68   | 41                  | 12  | 14      |   | 41       | -                    | - 6  | 6 27        | - [              |                  |          | -                 |                     |                            | 0.0   |
|           | i                      |              |      | 20   | 283                 | 83  | 97      |   | 41       | - 1                  | - 6  | 6 27        | ·                |                  |          |                   |                     |                            | 0.0   |
| ·10       | 0.04                   | 0            | ΤΥP  | 68   | 78                  | 72  | 76      |   | 2        | 83                   | Ŧ    | 71          | †                |                  |          |                   |                     |                            | 0.0   |
|           | 1                      |              |      | 20   | 538                 | 496   | 524     | -   | 2        | 83                   | Ţ    | 71          | Ţ                |                  |          | , 1               | _                   |                            | 0.0   |
| 101       | 0,04                   | C            | TYP  | 68   | 48                  |   | 41      |   |          | 50                   | _    | 51          | _                |                  |          |                   |                     |                            | 0.0   |
|           | 1                      |              |      | 20   |                     |   | 283     |   |          | 50                   | +    | 51          | -                |                  |          |                   |                     |                            | 0.0   |

<sup>\*</sup>Fatigue Strength: 100 x 10 <sup>8</sup>cycles, unless indicated as [N]X 106.

|                                  | US Customary   | Metric                                    |  |  |  |  |
|----------------------------------|--|---|--|--|--|--|
| Melting Point - Liquidus         | 1905 F   | 1041 C                                    |  |  |  |  |
| Melting Point - Solidus          | 1870 F   | 1021 C                                    |  |  |  |  |
| Density                          | 0.318 lb/in <sup>3</sup> at 68 F                           | 8.8 gm/cm <sup>3</sup> @ 20 C             |  |  |  |  |
| Specific Gravity                 | 8.8  | 8.8                                       |  |  |  |  |
| Electrical Resistivity           | 32.0 ohms-cmil/ft @ 68 F                                   | 5.32 microhm-cm @ 20 C                    |  |  |  |  |
| Electrical Conductivity          | 32 %IACS @ 68 F  | 0.187 MegaSiemens/cm @ 20 C               |  |  |  |  |
| Thermal Conductivity             | 75.0 Btu · ft/(hr · ft2·ºF)at 68F                          | 129.8 W/m · °K at 20 C                    |  |  |  |  |
| Coefficient of Thermal Expans    | sion 10.2 · 10 <sup>-8</sup> per <sup>o</sup> F (68-212 F) | 18.4 · 10 <sup>-6</sup> per °C (20-100 C) |  |  |  |  |
| Specific Heat Capacity           | 0.09 Btu/lb/°F at 68 F                                     | 377.1 J/kg ⋅ ºK at 293 K                  |  |  |  |  |
| Modulas of Elasticity in Tension | n* 18000 ksi   | 124000 MPa                                |  |  |  |  |
| Modulus of Rigidity              | 6700 ksi   | 46200 MPa                                 |  |  |  |  |

Copper.org: Resources: Standards & Properties - Properties of Wrought and Cast Copper Alloys ... Page 3 of 3

\*For annealed alloys.

**Tempers Most Commonly Used** 

| Flat Products |      |      |      |      |      |      |      |      |        |        |       |      |       |
|---------------|------|------|------|------|------|------|------|------|--------|--------|-------|------|-------|
| BAR, ROLLED   | H02, | H03, | H04  |      |      |      |      |      | -      |        |       |      |       |
| SHEET         | H00, | H01, | H02, | H03, | H04, | H06, | H08, | H10, | OS015  | , OS02 | 5, OS | 035, | OS050 |
| STRIP, ROLLED | H01, | H02, | H03, | H04  | H06, | H08, | H10, | OS01 | 5, OSC | 25, OS | 035,  | 050  | 50    |

Other WIREH04

Typical Uses

Electrical

Fuse Clips, Terminals, Conductors, Electrical Connectors

Industrial

Thrust Washers, Flexible Hose, Bushings, Bearings, Bearing Sleeves

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### Copper one

### **Search Results**

C42200

Last Updated: Apr 28, 2008

**Chemical Composition** 

 Cu
 Fe
 Ph
 P
 Sn
 Zn

 Min./Max.86.0-89.0
 05.05.35.8-1.4
 Rem.

 Nominal
 87.5
 1.1
 11.4

Note: Cu + Sum of Named Elements, 99.7% min.

Applicable Specifications

| Product     | Specification   |
|-------------|-----------------|
| Bar, Rolled | ASTM B591       |
| Plate       | ASTM B591       |
| Sheet       | ASTM B591       |
| Strip       | ASTM B888, B591 |

### **Common Fabrication Processes**

Blanking, Drawing, Forming, Piercing and Punching

**Fabrication Properties** 

| Paprication Properties         |                 |
|--------------------------------|-----------------|
| Joining Technique              | Suitability     |
| Soldering                      | Excellent       |
| Brazing                        | Fair            |
| Oxyacetylene Welding           | Not Recommended |
| Gas Shielded Arc Welding       | Excellent       |
| Spot Weld                      | Good            |
| Seam Weld                      | Fair            |
| Butt Weld                      | Good            |
| Capacity for Being Cold Worked | dExcellent      |
| Capacity for Being Hot Formed  | Good            |
| Machinability Rating           | 30              |

Mechanical Properties (measured at room temperature, 68 F (20 C)

| Temper | Section<br>Size | Cold<br>Work | Typ/<br>Min | (emp | Tensile<br>Strongth | Yisid<br>Strength<br>(0.5% ext.<br>under load) | Strength<br>(0.2% | Yield<br>Strength<br>(0,05%<br>offset) | ΕI | Rockwell<br>Hardness | Vickens<br>Hard. | Bdnell<br>Hard. | Shear<br>Strength | Fatigue<br>Strength | izod<br>Impact<br>Strength |
|--------|-----------------|--------------|-------------|------|---------------------|--|-------------------|--|----|----------------------|------------------|-----------------|-------------------|---------------------|----------------------------|
|        | 1               |              |             |      |                     | unuer ivau                                     | (O) (ART)         | C112 0()                               |    |                      |                  |                 |                   |                     |                            |

|          | in.    | %               | 1_                                     | F        | ksi         | ksi | ksi | kal  | 145 | В        | d  | F  | 36T | 500      | 500            | 300  | Oksi         | ksi          | ſt-lb |
|----------|--------|-----------------|--|----------|-------------|-----|-----|--|-----|----------|----|----|-----|----------|----------------|--|--------------|--------------|-------|
|          | mm.    |                 | T                                      | <b>c</b> | MPa         | MPa | MPa | MРа  | T   |          | П  |    |     |          | 7              | T  | MPa          | МРя          | J     |
| Flat Pro | oducts |                 |  |          |             |     |     |  |     | -        |    |    |     | •        |                |  |              |              |       |
| OS015    | 0.04   | 0               | TYP                                    | BB.      | 46          | 17  | 19  |  | 44  | E        | -  | 75 | 40  | -        | _[-            | F  | F            | T            | 0.0   |
|          | 1      |                 | 1                                      | 20       | 317         | 117 | 131 | -  | 44  | Γ        | -  | 7ŝ | 10  | F        | Ţ              | F  | -            | F            | 0.0   |
| H02      | 0.04   | D               | TYP                                    | 68       | 6Ü          | 51  | 57  | 1  | 12  | 70       | П  | T  | 84  | -        | 1              | ┇  | 厂            | +-           | 0.0   |
|          | 1      |                 |  | 20       | 414         | 352 | 393 | Ţ. —   | 12  | 70       |    | П  | 64  |          | Τ,             | Į.   | Ţ.           |              | 0.0   |
| OS035    | 0.04   | 0               | TYP                                    | 38       | 43          | 15  | 14  | 1-   | 46  | F        | Н  | ūδ | 27  | _        | +-             | ┢  | +            | <del>-</del> | 0,0   |
|          | 1      |                 | T                                      | 20       | 296         | 103 | 97  | Ţ-   | 46  | Г        | П  | 55 | 27  |          | T              | Ι-   |              |              | 0.0   |
| HQS      | 0.04   | 0               | TYP                                    | 38       | 80          | 85  | 76  | +  | В   | 84       | Н  | H  | 72  | _        | ╁              | !  |              |              | 0.0   |
|          | 1      |                 | 1                                      | 20       | 552         | 469 | 524 | 1.   | - 6 | 84       | П  | -1 | 72  |          | _              | ţ.   |              | <u> </u>     | 0.0   |
| ноз      | 0.04   | 0               | ΤÝΡ                                    | 58       | 66          | 55  | 94  | ╪╼   | 6   | -        | Н  | _  | 58  | _        | +-             | ╌  | <del>[</del> | ┿            | 0.6   |
|          | 1      |                 |  | 20       | 455         | 379 | 441 | 1  | 6   | 77       | H  | -  | 68  |          | ╅              | ţ.   |              | <b>T</b>     | 0.0   |
| 104      | 0.04   | 0               | ΤÝΡ                                    | 88       | 73          | B5  | 70  | +-   | _   | В        | Н  |    | 70  |          | ╁╌             | ╌  | ╁─           | <del>-</del> | 0.0   |
|          | 1      | 1               | 1                                      | 20       | 503         | 448 | 483 | _  | 1   | В        | H  | -  | 70  |          | 1              | t  | 1            | 1            | 0.0   |
| 108      | 0.04   | 6               | ΤΥΡ                                    | _        | 87          | 73  | 81  | <del>-                                    </del> |     | 67       | Н  | _  | 73  | _        | <del>-[-</del> | <del>[                                    </del> | <del>[</del> | -{           | 0.0   |
|          | 1      | +               |  | 20       | 500         | 503 | ŝ58 | +-   | _   | 67       | H  | -  | 73  | _        | ┰              | F-   | <del></del>  |              | 0.0   |
| OS025    | 0.04   | 0               | TYP                                    | _        | 44          | 16  | 15  | <del>-[</del>                                    | 45  | _        | Н  | 70 |     |          | ╌              | <del>[ -</del>                                   | <u> </u>     |              | 0.0   |
|          | 1      | Ť               | + ''                                   | 20       | 303         | 110 | 103 | Ŧ  | 45  | -        | н  | 70 | ÷   | Ε        | ╌              | ┡  | <del>-</del> | +            | 0.0   |
| 110      | 0.04   | 6               | TYP                                    | _        | 38          | 75  | 84  | -  |     | _        | Ц  | _  |     | _        |                | <b>!</b> —                                       | ļ            | _            |       |
| 110      | 1      | <del>ſ</del> -  | 117                                    | 20       | 607         | 617 | _   | ╄─   | +   | 56<br>26 | H  | -  | 74  | <u> </u> | ╁              | ┞  | <del> </del> | +            | 0.0   |
| 101      | 0.04   | 0               | TYP                                    |          | 52<br>52    |     | 579 | ᅷ—   | _ P | 86       | H  | _  | 74  |          | 上              | ᆫ  | <u> </u>     | <u> </u>     | 0.0   |
| וטר      | u.u4   | <del>-  -</del> | +                                      | _        | <del></del> | 40  | 39  | +  | _   | 8        | H  | -  | 54  | _        | ╄              | ⇤  | <u> </u>     | <del> </del> | 0.0   |
|          | 1      |                 | ــــــــــــــــــــــــــــــــــــــ | 20       | 259         | 276 | 269 | ŀ  | 30  | 56       | ⊦ŀ | .  | 54  | ŀ        | ŀ              | ŀ  | ŀ            | ŀ            | 0.0   |

<sup>\*</sup>Fatigue Strength: 100 x 10 <sup>8</sup>cycles, unless indicated as [N]X 10<sup>8</sup>.

**Physical Properties** 

|                                | US Customary                      | Metric                        |
|--------------------------------|-----------------------------------|-------------------------------|
| Melting Point - Liquidus       | 1905 F                            | 1041 C                        |
| Melting Point - Solidus        | 1870 F                            | 1021 C                        |
| Density                        | 0.318 lb/in <sup>3</sup> at 68 F  | 8.8 gm/cm <sup>3</sup> @ 20 C |
| Specific Gravity               | 8.8                               | 8.8                           |
| Electrical Resistivity         | 33.0 ohms-cmil/ft @ 68 F          | 5.49 microhm-cm @ 20 C        |
| Electrical Conductivity*       |                                   | 0.181 MegaSiemens/cm @ 20 C   |
| Thermal Conductivity           | 75.0 Btu · ft/(hr · ft2·°F)at 68F |                               |
| Specific Heat Capacity         | 0.09 Btu/lb/ºF at 68 F            | 377.1 J/kg ⋅ ºK at 293 K      |
| Modulas of Elasticity in Tensi | on**18000 ksi                     | 124000 MPa                    |

<sup>\*</sup>To achieve a conductivity of 31% IACS, phosphorus shall be .07% maximum.

**Tempers Most Commonly Used** 

| Tempera most o | zonniomy oseu  |
|----------------|--|
| Flat Products  |  |
| BAR, ROLLED    | H02, H03, H04  |
| SHEET          | H01, H02, H03, H04, H06, H08, H10, OS015, OS025, OS035 |
| STRIP, ROLLED  | H01, H02, H03, H04, H06, H08, H10, OS016, OS025, OS035 |

# Typical Uses Electrical Connectors, Fuse Clips, Terminals, Electrical Connectors Fasteners Spring Washers

<sup>\*\*</sup>For annealed alloys.

printed 06/01/2011 11:04AM by Luttie.Boarman p. 146/361

Copper.org: Resources: Standards & Properties - Properties of Wrought and Cast Copper Alloys ... Page 3 of 3

#### Industrial

Bushings, Contact Springs, Sash Chain

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### Copperam

上版書類的表記 经制定 新疆 型的磁性系统 经基础的 网络马斯特 的

### **Search Results**

C44300 (Admiralty, Arsenical)

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           |                   |       |     |    | Sn <sup>(1)</sup> |      |
|-----------|-------------------|-------|-----|----|-------------------|------|
| Min./Max. | <u>70.</u> 0-73.0 | 02-06 | .06 | 07 | .8-1.2            | Rem. |
| Nominal   | 71.0              | .04   | ,   | ·  | 1.0               | 28.0 |

(1) For tubular products, the minimum Sn content may be .9%. Note: Cu + Sum of Named Elements, 99.6% min.

**Applicable Specifications** 

| Product               | Specification           |
|-----------------------|-------------------------|
| Plate, Clad           | ASTM B432               |
| Plate, Condenser Tube | ASME SB171<br>ASTM B171 |
| Tube                  | ASTM B135               |
| Tube, Condenser       | ASME SB111<br>ASTM B111 |
| Tube, Finned          | ASME SB359<br>ASTM B359 |
| Tube, U-Bend          | ASME SB395<br>ASTM B395 |
| Tube, Welded          | ASME SB543<br>ASTM B543 |

### **Common Fabrication Processes**

Bending, Forming, Machining

**Fabrication Properties** 

| Joining Technique        | Suitability     |  |  |  |  |  |  |  |
|--------------------------|-----------------|--|--|--|--|--|--|--|
| Soldering                | Excellent       |  |  |  |  |  |  |  |
| Brazing                  | Excellent       |  |  |  |  |  |  |  |
| Oxyacetylene Welding     | Good            |  |  |  |  |  |  |  |
| Gas Shielded Arc Welding | Fair            |  |  |  |  |  |  |  |
| Coated Metal Arc Welding | Not Recommended |  |  |  |  |  |  |  |
| Spot Weld                | Good            |  |  |  |  |  |  |  |

| Seam Weld                      | Not Recommended |
|--------------------------------|-----------------|
| Butt Weld                      | Good            |
| Capacity for Being Cold Worked | Excellent       |
| Capacity for Being Hot Formed  | Fair            |
| Machinability Rating           | 30              |

Mechanical Properties (measured at room temperature, 68 F (20 C)

| Temper   | Section<br>Size | Cold<br>Work | Typ/<br>Min | Temp | Tenzile<br>Strength | Svength | Strangth<br>(0.2% | Yield<br>Strength<br>(0.05%<br>offsat) | Εı         | Ro<br>H | oc k | WB<br>nes | ()<br>() | Vickens<br>Hard.                             | Brli<br>Har | neli<br>d. |     | rangue<br>Steventh | izod<br>Impact<br>Stren <del>gti</del> |
|----------|-----------------|--------------|-------------|------|---------------------|---------|-------------------|--|------------|---------|------|-----------|----------|--|-------------|------------|-----|--------------------|--|
|          | п.              | <b>3</b> 9   |             | ш    | hsi                 | ksi     | ksi               | ksi                                    | ж,         | 8       | CF   | F         | 01       | 500  | 500         | 3000       | kei | ksi                | t⊰b                                    |
|          | mm.             |              |             | c    | MPa                 | MPa     | MPa               | мРа                                    | Г          | П       | T    | T         |          |  |             |            | мРа | MPa                | J                                      |
| Plate    |                 |              |             |      |                     |         |                   |  |            |         |      |           | _        |  | _           |            |     |                    |  |
| M20      | 1               | 0            | TYP         | 68   | 48                  | 18      |                   |  | <b>3</b> 5 | ŀĪ      | ٦.   | ₫-        |          | ļ.   | F           |            | F   | -                  | 0.0                                    |
| <u>.</u> | 25.4            |              |             | 20   | 031                 | 124     |                   | -                                      | 55         | H       | - 7  | d-        |          |  | F           |            |     |                    | 0.0                                    |
| Wire     |                 |              |             |      |                     |         |                   |  | •          | _       | _    | _         |          |  |             |            |     |                    |  |
| OS015    | 80.0            | 0            | TYP         | 88   | 55                  |         | -                 |  | 60         | П       | T    | Ŧ         |          | <u>-                                    </u> | F           | F          | F   | -                  | 00                                     |
|          | 2               |              |             | 20   | 379                 |         | -                 |  | 60         | F.      | Ŧ    | ŀ         |          |  |             | -          | -   | -                  | 0.0                                    |
| Tube     |                 |              |             |      |                     |         |                   |  | _          | _       | •    | _         |          |  | _           |            |     | ļ                  |  |
| OS025    | 0.0             | 0            | ΤŸΡ         | 68   | 53                  | 22      | ,                 |  | 65         | П       | Ŧ    | 5 5       | 7        | -  | F           | -          | F   |                    | 0.0                                    |
|          | 0.0             |              |             | 20   | 365                 | 152     |                   | _                                      | 65         | IJ      | 17   | 533       | 7        | -  |             |            | -   |                    | 0.0                                    |

<sup>\*</sup>Fatigue Strength: 100 x 10 <sup>6</sup>cycles, unless indicated as [N]X 10<sup>6</sup>.

**Physical Properties** 

|                                  | US Customary                                   | Metric                                   |
|----------------------------------|--|--|
| Melting Point - Liquidus         | 1720 F   | 938 C                                    |
| Melting Point - Solidus          | 1650 F   | 899 C                                    |
|                                  | 0.308 lb/in <sup>3</sup> at 68 F               | 8.53 gm/cm <sup>3</sup> @ 20 C           |
| Specific Gravity                 | 8.53   | 8.53                                     |
| Electrical Resistivity           | 41.5 ohms-cmil/ft @ 68 F                       | 6.9 microhm-cm @ 20 C                    |
| Electrical Conductivity          |  | 0.146 MegaSiemens/cm @ 20 C              |
| Thermal Conductivity             | 64.0 Btu · ft/(hr · ft2· <sup>o</sup> F)at 68F | 110.8 W/m · ºK at 20 C                   |
| Coefficient of Thermal Expansion | 11.2 ·10 <sup>-6</sup> per °F (68-572 F)       | 20.2 ·10 <sup>-6</sup> per °C (20-300 C) |
| Specific Heat Capacity           |  | 377.1 J/kg · ºK at 293 K                 |
| Modulas of Elasticity in Tension | 16000 ksi                                      | 110000 MPa                               |
| Modulus of Rigidity              | 6000 ksi                                       | 41370 MPa                                |

### Tempers Most Commonly Used

Flat Products PLATE M20

| Other |        |
|-------|--------|
| TUBE  | OS025  |
| WIRE  | O\$015 |

### Typical Uses

Industrial

Evaporator Tubing, Heat Exchanger Tubing, Condenser Tube Plates, Distiller Tubes, Oil Well Pump Liner, Ferrules, Bourdon Tubes, Condenser Tubes

Plumbing Strainers printed 06/01/2011 11:04AM by Luttie.Boarman p. 150/361

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### Copper.on

文件 机压抑光体 曲加加层 表明 阿思索斯氏三多 咖啡 氯化树脂 等距 对地震器 華寶女林

### **Search Results**

C46400 (Naval Brass, Uninhibited)

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           |           | E  |     |         | Zn   |
|-----------|-----------|----|-----|---------|------|
| Min./Max. | 59.0-62.0 | 10 | .20 | .50-1.0 | Rem. |
| Nominal   | 60.0      |    |     | .7      | 39.2 |

Note: Cu + Sum of Named Elements, 99.6% min.

**Applicable Specifications** 

| Product               | Specification  |
|-----------------------|--|
| Bar                   | AMS 4611, 4612<br>ASTM B21<br>FEDERAL QQ-B-639<br>SAE J463, J461 |
| Bar, Forging          | ASTM B124  |
| Bolts                 | ASTM F468  |
| Forgings, Die         | ASTM B283  |
| Nuts                  | ASTM F467  |
| Plate                 | FEDERAL QQ-B-639   |
| Plate, Clad           | ASTM B432  |
| Piate, Condenser Tube | ASME SB171<br>ASTM B171  |
| Rod                   | AMS 4611, 4612<br>ASTM B21<br>SAE J463, J461                     |
| Rod, Forging          | ASTM B124  |
| Screws                | ASTM F468  |
| Shapes                | ASTM B21   |
| Shapes, Forging       | ASTM B124  |
| Sheet                 | FEDERAL QQ-B-639   |
| Strip                 | FEDERAL QQ-B-639<br>SAE J461, J463                               |
| Studs                 | ASTM F468  |
| Wire, Metallizing     | MILITARY MIL-W-6712  |

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Common Fabrication Processes
Blanking, Drawing, Forming and Bending, Heading and Upsetting, Hot Forging and Pressing, Hot Heading and Upsetting, Shearing

**Fabrication Properties** 

| Joining Technique              | Suitability     |
|--------------------------------|-----------------|
| Soldering                      | Excellent       |
| Brazing                        | Excellent       |
| Oxyacetylene Welding           | Good            |
| Gas Shielded Arc Welding       | Fair            |
| Coated Metal Arc Welding       | Not Recommended |
| Spot Weld                      | Good            |
| Seam Weld                      | Fair            |
| Butt Weld                      | Good            |
| Capacity for Being Cold Worked |                 |
| Capacity for Being Hot Formed  | Excellent       |
| Forgeability Rating            | 90              |
| Machinability Rating           | 30              |

| Mechanical Prop | perties (measure | d at room tem | perature, 68 F (20 C) |
|-----------------|------------------|---------------|-----------------------|
|                 |                  |               |                       |

|              | T                | <del>' ' '</del> | 7 7 7         | 1600 | 7 (1110-02          | Suicu at   |          |  | 110      | ш        | e e t  | 3, 0       | 30 I          | FIZU           |           | <u> </u>      |                   |                     |                           |
|--------------|------------------|------------------|---------------|------|---------------------|------------|----------|--|----------|----------|--------|------------|---------------|----------------|-----------|---------------|-------------------|---------------------|---------------------------|
| Tempe        | Section<br>Size  | Cold<br>Work     | Typ<br>Min    |      | Tensile<br>Strength | Strength   |          | Yield<br>Strength<br>(0.05%<br>offset) | ΞI       | Ro<br>Hz | ock    | een<br>Pen | ‼ Vi<br>⊯ H:  | ickens<br>ard. | Bri<br>Ha | nell<br>rd.   | Shear<br>Strength | Fatigue<br>Strength | tzod<br>Impact<br>Strengt |
|              | in.              | %<br>—           | L             | F    | ksi                 | ksi        | ksi      | ksi                                    | %        | В        | С      | 30         | ) T 50        | 00             | 500       | 3000          | ksi               | ksi                 | ft-fb                     |
|              | മ്പമ്പ.          | L_               |               | С    | MPa                 | MPa        | MPa      | MPa                                    |          | Γ        |        | Π          |               |                |           |               | MPa               | MPa                 | J.                        |
| Tube         |                  |                  |               |      |                     | _          |          |  | •        |          |        |            |               |                |           |               |                   | 1                   | -                         |
| H80          | 0.0              | 35               | TYP           | _    | 88                  | <b>3</b> 6 | ,        | _                                      | 18       | 35       | Ł      | ŀ          | Œ             |                | Ы         | F             |                   | -                   | 0.0                       |
|              | 0,0              | L                |               | 20   | 607                 | 455        | <u> </u> | ŀ                                      | 18       | 95       | H      |            | F             |                | F         | -             | -                 |                     | 0.0                       |
|              | oducta           |                  |               |      |                     |            |          |  |          |          |        |            |               |                |           |               |                   |                     |                           |
| 050          | 0.04             | 0                | ΤΥΡ           | _    | 62                  | 30         |          | <u> </u>                               | 40       | Ġί       | Ð      | - 5,       | Ŀ             |                | L         | F             | 41                |                     | 0.0                       |
|              | <u>†</u>         |                  |               | 20   | 427                 | 207        | ŀ        | ŀ                                      | 40       | 60       | FT     | - 5        | , F           |                | L         | ,             | 293               |                     | 0.0                       |
| Rod          |                  |                  |               |      |                     |            |          |  |          |          |        |            |               |                |           |               |                   |                     | 1                         |
| H01          |                  | 8                | TYP           | _    | 57                  | 40         |          |  | 35       | 75       | $\Box$ |            | Ŧ             |                | Ш         | Ŀ             | 43                |                     | 0.0                       |
|              | 51               |                  |               | 20   | 462                 | 278        | -        |  | 35       | 75       | П      |            | F             |                |           |               | 296               |                     | 0.0                       |
| O50          | 1                | 0 ,              | TYP           | 58   | 63                  | 30         | _        |  | 40       | 60       | Н      | †          | ✝             |                | Ε-        | $\vdash$      | 42                |                     | 0.0                       |
|              | 25,4             |                  |               | 20   | 434                 | 207        |          | ,                                      | 40       | 80       | П      | T          | T             |                |           | _             | 290               |                     | 0,0                       |
| C80          | 1                | 0                | түр           | 68   | 57                  | 25         |          | _                                      |          | 55       | H      | +          | ╁             |                | H         |               | 40                |                     | 0.0                       |
|              | 25.4             |                  |               | 20   | 393                 | 172        |          |  | 47.      |          | -      | 1          | 十             |                |           | •             | 276               |                     | 0.0                       |
| Q <u>6</u> 0 | 0.25             | 0                | Τγρ           | 68   | 58                  | 27         | _        |  | 45       |          |        | t          | <del>-</del>  |                |           |               | 40                |                     | 0.0                       |
| -            | 6.35             |                  |               | 20   | 400                 | 186        |          |  | 45       |          |        |            | t             |                |           |               | 276               |                     | 0.0                       |
| H01          | 0.25             | 10               | ΥP            | 68   | 70                  | 48         |          |  | 25       |          |        |            | ╅╴            | -              |           | -             | 43                |                     | 0.0                       |
| ***          | 6.35             |                  |               | 20   |                     | 331        |          |  | 25       |          | H      | Ŧ          | ┲             | $\neg \dashv$  |           | _             | 298               |                     | _                         |
| Flat Pro     | xlucts           |                  | _             |      |                     |            |          |  |          | 00       |        |            |               |                |           |               | 490               | ·                   | 0.0                       |
| V120         |                  | Ď                | TYP           | 68   | 55                  | 25         |          |  | 5n       | 5.5      | Π.     | 55         |               |                |           |               | 40                |                     | 0.0                       |
|              | 25,4             |                  |               | 20   | 379                 | 172        |          |  |          | _        | •      | 55         | _             |                |           |               | 276               |                     | 0.0                       |
| 060          | 0.25             | 0                | ΤΥΡ           |      |                     | 25         |          |  |          | _        | _      | 55         | _             |                | _         |               | 40                |                     |                           |
|              | 5.35             |                  | _             | Į    |                     | 172        |          |  | 49       | _        | _      | 55         | _             |                | -         | -             |                   | _                   | 0.0                       |
| ₹od          |                  | ليب              |               | 4,0  | 100                 | 172        |          |  | 48       | ΟĐ       | ŀ      | 93         | ŀ.            |                | •         | `             | 276               | •                   | 0.0                       |
|              | 0.25             | 20               | TYP           | 68   | 80                  | 57         | 1        |  | 20       | oci      | τ      | Ŧ          | Т             |                | _         |               | 45                |                     |                           |
|              | 6.35             |                  | _             | _    | -                   | 393        |          |  | 20       | _        | Ŧ      | ┢          | ╄             |                | -         | ightharpoonup | 310               |                     | 0.0                       |
| lat Pro      |                  |                  | _             |      |                     | 000        |          |  | ۷Y       | 9        | ľ      | Ϊ          | ŀ.            |                | •         |               | 310               |                     | 00                        |
| 050          |                  | 0                | TYP           | 68   | 90                  | 28         |          | _                                      | 15       | c cl     | τ      | 56         | $\overline{}$ |                | _         | <u> </u>      | 41                |                     | 0.0                       |
|              | 6.3 <del>5</del> |                  | $\overline{}$ |      |                     | 193        |          |  | _        | -        | -      | -          | ╄             |                |           |               |                   |                     |                           |
| Rod          |                  |                  |               |      |                     |            | [        |  | ."       | "1       | 1      | 58         | 1             |                |           |               | 283               | ·                   | 0.0                       |
|              | 1 1              | 9 1              | TYP           | 68   | 59                  | 18         | . 1      |  | 27       | 7 g T    | Т      | T.         | 7             |                | _         | r             | 13                | <del>- ,</del>      |                           |
|              | 25,4             | 寸                |               | _    | _                   | 317        |          |  | 27<br>27 | _        | _      | F          | チ             |                | Н         | _             |                   |                     | 0.0                       |
| _            | 2                | <del>, ·</del>   | ΪΥΡ           |      |                     | 28         |          |  | -        | _        | _      | _          | ╄             |                | _         |               | 296               |                     | 0.0                       |
|              | ┡╌╌╂             | <del>-  </del>   | 117           | υQ   | <b>υ</b> Δ          | 40         |          |  | 13       | Ч        | ‡      | Ľ          | ŧ.            |                | _         |               | 12                |                     | 0.0                       |

|        | <b>6</b> 1 | 1  |     | 20 | 427 | 193 | ŀ   | ŀ | kakal   | - 1  | 1.               | 290 | 0.0   |
|--------|------------|----|-----|----|-----|-----|-----|---|---------|------|------------------|-----|-------|
| H02    | 1          | 20 | TYP | 58 | 75  | 53  |     |   | 2082-   |      |                  | 44  | . 0.0 |
|        | 25.4       |    |     | 20 | 517 | 365 | - F | T | 20 82 - |      | $\top$           | 303 | 0.0   |
| O50    | 0.25       | 0  | TYP | 68 | 53  | 30  | Ŧ.  |   | 40 30-  |      | 1 1              | 42  | 0.0   |
|        | 6.35       |    |     | 20 | 434 | 207 | F   | 7 | 4060    | -    |                  | 290 | 0.0   |
| Q60    | 2          | O  | TYP | 68 | 56  | 25_ |     |   | 4755    |      | <del>- - -</del> | 40  | 3.0   |
|        | 51         |    |     | 20 | 386 | 172 | -   | Ŧ | 4755    |      | - I              | 276 | 0.0   |
| Flat P | oducts     |    |     |    |     |     |     |   |         |      |                  |     | Fit   |
| HO1    | 0.04       | 0  | TYP | 68 | 70  | 58  | F   |   | 1775    | - 88 | FF               | 43  | 0.0   |
|        | 1          | 1  | I   | 20 | 483 | 400 | Ŧ-  | - | 1775    | 5B - | ŦŦ               | 296 | 0,0   |

\*Fatigue Strength: 100 x 10 <sup>6</sup>cycles, unless indicated as [N]X 10<sup>6</sup>.

**Physical Properties** 

|                                  | US Customary                             | Metric                                   |
|----------------------------------|--|--|
| Melting Point - Liquidus         | 1650 F                                   | 899 C                                    |
| Melting Point - Solidus          | 1630 F                                   | 888 C                                    |
| Density                          | 0.304 lb/in <sup>3</sup> at 68 F         | 8.41 gm/cm <sup>3</sup> @ 20 C           |
| Specific Gravity                 |  | 8.41                                     |
| Electrical Resistivity           | 39.9 ohms-cmil/ft @ 68 F                 | 6.63 microhm-cm @ 20 C                   |
| Electrical Conductivity          |  | 0.152 MegaSiemens/cm @ 20 C              |
| Thermal Conductivity             | 67.0 Btu - ft/(hr - ft2-°F)at 68F        |  |
| Coefficient of Thermal Expansion | 11.8 ·10 <sup>-6</sup> per °F (68-572 F) | 21.2 ·10 <sup>-6</sup> per °C (20-300 C) |
| Specific Heat Capacity           |  | 377.1 J/kg • °K at 293 K                 |
| Modulas of Elasticity in Tension | 15000 ksi                                | 103400 MPa                               |
| Modulus of Rigidity              | 5600 ksi                                 | 38610 MPa                                |

**Tempers Most Commonly Used** 

| Flat Products |                    |
|---------------|--------------------|
| BAR, DRAWN    | H01, H02, O50, O60 |
| BAR, ROLLED   | H01, O50, O60      |
| PLATE         | H02, M20, O60      |
| STRIP, ROLLED | H01, O50           |

| Other  |      |      |      |      |     |
|--------|------|------|------|------|-----|
| ROD    | H01, | H02, | M30, | O50, | O60 |
| SHAPES | H01, | M30  |      |      |     |
| TUBE   | H58, | H80  |      |      |     |

### Typical Uses Builders Hardware

Lock Pins

**Electrical** 

Precision Shipboard Equipment

**Fasteners** 

Rivets, Bolts, Nuts

Industrial

Welding Rod. Condenser Plates, Structural Uses, Valve Stems, Balls, Heat Exchanger Tube, Aircraft Turn buckle Barrels, Bearings. Dies, Golf Ball Production, Pressure Vessels, Bearings, Bushings, Hub Cones

Propeller Shafts, Marine Hardware, Decorative Fittings, Shafting, Propeller Shafts, Turn buckles Ordnance

Missile Components
Other
Baffle Plates and Flanges
Plumbing
Fittings

Start Another Search

### DISCLAIMER:

The values listed above represent reasonable approximations suitable for general engineering use. Due to commercial variations in compositions and to manufacturing limitations, they should not be used for specification purposes. See applicable ASTM International specification references.

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Copper Connects Life<sup>TM</sup>



## Copper,on

### **Search Results**

C51000 (Phosphor Bronze, 5% A)

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           | Cu   | Fe  | Pb  | Ρ     | Sn      | Zn  |
|-----------|------|-----|-----|-------|---------|-----|
| Min./Max. | Rem. | .10 | .05 | .0335 | 4.2-5.8 | .30 |
| Nominal   | 94.8 |     | ,   | .20   | 5.0     | •   |

Note: Cu + Sum of Named Elements, 99.5% min.

**Applicable Specifications** 

| Product                                      | Specification        |
|--|----------------------|
| Bar  | AMS 4625             |
| <u>                                     </u> | ASTM B139, B103      |
| Bearings and Bushings                        | MILITARY MIL-B-13501 |
| Bolts  | ASTM F468            |
| Bushing Stock                                | MILITARY MIL-B-13501 |
| Nuts   | ASTM F467            |
| Plate  | AMS 4510             |
|  | ASTM B103            |
| Plate, Bridge and Bearing                    | ASTM B100            |
| Rod  | AMS 4625             |
|  | ASTM B139            |
|  | SAE J461, J463       |
| Screws                                       | ASTM F468            |
| Shapes .                                     | ASTM B139            |
| Sheet  | AMS 4510             |
|  | ASTM B103            |
|  | SAE J463, J461       |
| Sheet, Bridge and Bearing                    | ASTM B100            |
| Strip  | AMS 4510             |
|  | ASTM B103, B888      |
|  | SAE J461, J463       |
| Studs  | ASTM F468            |
| Tube   | AMS 4625             |
|  | MILITARY MIL-T-3595  |
|  | · <del></del>        |

| Wire              | AMS 4720            |
|-------------------|---------------------|
|                   | ASTM B159           |
|                   | SAE J461, J463      |
| Wire, Metallizing | MILITARY MIL-W-6712 |

### **Common Fabrication Processes**

Blanking, Drawing. Forming and Bending, Heading and Upsetting, Roll Threading and Knurting, Shearing, Stamping

**Fabrication Properties** 

| Joining Technique              | Sultability |
|--------------------------------|-------------|
| Soldering                      | Excellent   |
| Brazing                        | Excellent   |
| Oxyacetylene Welding           | Fair        |
| Gas Shielded Arc Welding       | Good        |
| Coated Metal Arc Welding       | Fair        |
| Spot Weld                      | Good        |
| Seam Weld                      | Fair        |
| Butt Weld                      | Excellent   |
| Capacity for Being Cold Worked | Excellent   |
| Capacity for Being Hot Formed  | Poor        |
| Machinability Rating           | 20          |

| Mechanical Properties | measured at re | nom femnerature | 68 F (20 C) |
|-----------------------|----------------|-----------------|-------------|
|                       |                |                 |             |

| 1010011  | utilied         | , , ,,       | יטעי        | HCS | fillens             | mien ar  | COUNT             | emper.                                 | 41       | u        | 16         | ٠, ١       | יסט        | I \              | -         |          |     |                     |                            |
|----------|-----------------|--------------|-------------|-----|---------------------|----------|-------------------|--|----------|----------|------------|------------|------------|------------------|-----------|----------|-----|---------------------|----------------------------|
| Temper   | Section<br>Size | Cold<br>Work | Typ/<br>Min | _   | Tensile<br>Strength | Strength | Strongth<br>(0.2% | Yleld<br>Strength<br>(0.05%<br>offset) | ΕI       | Ro<br>Hi | eci<br>Rro | kw<br>Ing  | eli<br>ISS | Vickens<br>Hard. | Bri<br>Ha |          |     | Fatigue<br>Strength | trod<br>Impact<br>Strengti |
|          | in.             | <b>%</b>     |             | F   | ksi                 | ksi      | KSI               | ksi                                    | %        | B        | c          | ۲          | 30T        | 500              | 500       | 3000     | ksi | ksi                 | fi⊣b                       |
|          | mm.             |              |             | c   | МРв                 | MPa      | мРа               | MPa                                    | Γ        | Γ        | Γ          | Π          |            |                  | Ī         |          | MPa | MPa                 | J                          |
| Flat Pro |                 |              |             |     |                     |          |                   |  |          | -        |            |            |            |                  | _         | •        |     |                     |                            |
| M20      | 0.0             | 0            | ТҮР         | 68  | 50                  |          |                   | Ļ.                                     | E        | E        | ŀ          | Ŀ          | -          |                  | ŀ         | ŀ        | _   |                     | 0.0                        |
|          | 0.0             | L            |             | 20  | 345                 | -        | <b> </b> -        | ŀ                                      | F        | F        | F          | F          | -          | ļ.               | F         | F        |     | -                   | 0.0                        |
| OS015    | 0.04            | 0            | TYP         | 68  | 53                  | 22       |                   |  | 50       | 94       | F          | 76         | F          | -                | F         |          |     |                     | 0.0                        |
|          | 1               |              |             | 20  | 365                 | 152      |                   | -                                      | 50       | 34       | ŀ          | <b>?</b> 9 |            |                  | F         | F        |     |                     | 0.0                        |
| Wire     |                 |              |             |     |                     |          |                   |  | ٠        | _        | _          | _          |            |                  | _         | •        |     |                     |                            |
| H08      | 6,08            | 84           | TYP         | 68  | 140                 |          |                   | -                                      | 2        | ŀ        | ŀ          | Ŀ.         | -          | -                | -         | F        | -   |                     | 0.0                        |
|          | 2               |              |             | 20  | 965                 |          |                   |  | <u>.</u> | F        | F          | Г          | F          | -                | Ŀ         | <u> </u> |     |                     | 0.0                        |
| H01      | 0.08            | b            | TYP         | 38  | 68                  | 60       |                   |  | 24       | F        | t          | F          | F          | -                | ┌         |          | -   | _                   | 0.0                        |
|          | 2               |              |             | 20  | 469                 | 414      | -                 |  | 24       | Γ        | ŀ          | Γ          |            |                  | ŗ         | ŀ        | -   | -                   | 0.0                        |
| Flat Pro | ducte           |              |             |     |                     |          |                   |  |          | _        | _          | _          | _          |                  | •         |          |     |                     |                            |
| HROU     | 0.0             | C            | TYP         | 88  | 103                 | -        | 93                |  | 6        |          | F          |            | ŀ.         |                  | Ε.        | L        | -   | -                   | 0.0                        |
|          | 0.0             |              | ļ           | 20  | 710                 | -        | 641               | -                                      | 9        |          | ŀ          |            | -          | -                | ,         | F        | -   |                     | 0.0                        |
| 061      | 0.0             | ō            | SMIN        | 68  | <b>4</b> 5          |          | 13                | _                                      | 17       | Ŀ        | Ē          | L          | ŀ,         |                  | L         |          | -   |                     | 0.0                        |
|          | 0.0             |              |             | 20  | 315                 | -        | 90                | -                                      | 47       | -        | F          |            |            |                  | ,         | ·        |     |                     | 0.0                        |
| OS035    | 0.04            | 0            | TΥP         | 68  | 49                  | 20       |                   | -                                      | 58       | 28       | Ħ          | 75         |            |                  | _         | •        | -   |                     | 9.0                        |
|          | 1               |              |             | 20  | 338                 | 138      | -                 |  | 58       | 28       | ŀ          | 75         |            | -                |           | -        | _   |                     | 0.0                        |
| H06      | 0.04            | Q .          | TYP         | 58  | 98                  | _        | 92                | ,                                      | Ы        | 93       | H          | H          | 75         |                  | F         | F        |     | -                   | 0.0                        |
|          | 1               |              |             | 20  | <b>6</b> 62         |          | 634               |  | 5        | 93       | Γ          | _          | 78         |                  | Γ         | ŀ        |     | _                   | 0.0                        |
| HOT      | Ω.0             | 0            | SMIN        | 68  | 49                  |          | 20                |  | 24       |          | H          | H          |            |                  | L         | H        |     | -                   | 0.0                        |
|          | 0.0             |              |             | 20  | 340                 |          | 140               |  | 24       | L        | Ħ          | Π          |            |                  |           | t        |     |                     | 0.0                        |
| H04      | 0.04            | 0            | ŤΥΡ         | 68  | 84                  |          | 80                |  |          | 87       | H          | H          | 75         |                  | -         | H        |     | 25                  | 00                         |
|          | 1               |              |             |     | 579                 |          | 552               |  | -        | 87       | н          | 1          | 75         |                  | Ļ         | [.       |     |                     | 0.0                        |
| HR06     | 0.0             | 0            | TYP         |     | 96                  |          | 86                |  | 11       | H        | Н          | Н          | Ĥ          |                  | <u> </u>  | $\vdash$ |     |                     | Q.Q                        |
|          | 0.0             |              |             |     | 082                 |          | 593               |  | =        | H        | H          | Н          |            |                  |           | ᡛᢇᡰ      |     |                     | 0.0                        |
|          | 0.0             |              | TΥP         |     | 66                  |          | 54                |  | 23       | Н        | Н          | Н          | ├─         | . ,              | ┢         | ┞┈       |     |                     | 0.0                        |
|          | 0.0             |              | -           | 20  | 455                 |          | 372               |  | 28       | H        | Н          | H          | H          |                  | H         | $\vdash$ |     |                     | 0.0                        |
|          |                 | لــــا       | L           |     |                     |          | 27.4              |  |          |          |            |            | Г          |                  | ш         |          | []  |                     | ν,υ                        |

| 0.0<br>0.0<br>0.5 | 0   | ТҮР  | 20<br>68   | 710  | <b>-</b>   | 683  |  | $\overline{}$     |  |   |   |                   |                                     |                   |                   |                   | _                 |                   |
|-------------------|---|--|--|--|--|--|--|-------------------|--|---|---|-------------------|-------------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| 0.0<br>-          | 0   | ΓΥP  | GB   | 72.  |  | P003   |  | 3                 | ÐS   | ŀŀ  | 7:  | 9                 | -                                   | ŀ                 | ŀ                 | ŀ                 | 152               | 0.0               |
| •                 |   |  |  | 84   |  | 74   |  | 14                | П  | Ħ   | ŧ   |                   | -                                   |                   | F                 | 1                 | <b>†</b>          | 0.0               |
|                   | •   |  | 20   | 579  | <u> </u>   | 510  |  | 14                | F  | Τ.  | F   |                   |                                     | Į.                | Į.                | Ţ                 | Ţ.                | 0.0               |
| D. <b>S</b>       |   |  |  |  |  |  |  |                   |  | ~   | _   | _                 | •                                   | -                 |                   | -                 | -                 | —                 |
|                   | 20  | ТҮР  | 38   | 75   | 65   | F  |  | 25                | 80   | FŦ  | F   |                   | -                                   | ŀ                 | F                 | F                 | F                 | 0.0               |
| 12,7              |   |  | 20   | 517  | 448  | Ţ - Ţ  |  | 25                | 80   |   | Ŧ   |                   | L                                   | F                 | F                 | F                 | 1                 | 0.0               |
| 1                 | 20  | TYP  | 68   | 70   | 58   |  |  | 25                | 78   | Ħ   | Ŧ   |                   | <b>.</b>                            | F                 | <b>!</b>          | 1                 | 1                 | 0.0               |
| 25.4              |   |  | 20   | 483  | 400  | - I  |  | 25                | 78   | Ţ.  | Ŧ   |                   |                                     | F                 | F                 |                   | 1                 | 0,0               |
|                   |   |  |  |  |  |  |  | _                 | _  |   |   |                   |                                     | •                 | •                 | •                 | <u> </u>          |                   |
| 0.08              | 0   | קץד  | 68   | 110  | ]  | 1  |  | Э                 | E  | F   | Έ   |                   | Ш                                   | E                 | Ŧ                 | F                 | 27                | 0.0               |
| Ω                 |   |  | 20   | 758  | <u> </u>   | -  -  -  -  -  -  -  -  -  -  -  -  -  |  | 3                 | F  | ŀŀ  | F   |                   | -                                   | F                 | 1                 | 1                 | 186               | 0.0               |
| 0.08              | D   | ТҮР  | 68   | 50   | 20   | 1  |  | 58                |  | Į.  | Ī   |                   | -                                   | F                 | F                 | 1                 | +                 | 0.0               |
| 2                 |   |  | 20   | 345  | 138  | ļ ,  |  | 58                | Г  | Ι.  | Ţ   |                   |                                     | F                 | 1                 | 1                 | 1                 | 0.0               |
| ducts             |   |  | •  |  |  |  |  |                   |  | ш   |   | _                 |                                     | _                 |                   | -                 |                   |                   |
| 0.04              | n   | TYP  | 68   | 47   | 19   | ŀ  |  | 64                | 26   | þ   | '3-   |                   | -                                   | ŀ                 | ŀ                 | F                 | ŀ                 | 0.0               |
| 1                 |   |  | 20   | 324  | 131  | -  |  | 2.4               | 26   | - 7   | <b>'3</b> -   |                   | _                                   | F                 | F                 | -                 | Ţ                 | 0.0               |
|                   |   |  |  |  | -  |  |  | •                 | _  | _   |   |                   |                                     | -                 |                   | •                 | •                 |                   |
| 0.0B              | 75  | TYP  | 88   | 130  | ŀ  | _  |  | 3                 | E  | Ē   | ŀ   |                   | -                                   | F                 | <u>F.</u>         | ŀ                 | 30                | 0.0               |
| 2                 | 1   |  | 20   | 896  | 1  | - F  |  | 13                | F  | П   | Ŧ   |                   | -                                   | -                 | F                 | ļ.                | 207               | 0.0               |
| 80.0              | О   | ΤΥP  | 58   | 85   | 80   | Ţ  |  | В                 | F  | Ħ   | Ŧ   | ╗                 |                                     | ⇇                 | F                 | 1                 | ļ —               | 0.0               |
| 2                 |   |  | 20   | 586  | 5 <b>62</b>  | T- T-  |  | 8                 |  | - }-  | Ţ   | _                 |                                     | F                 | ŀ                 |                   | 1                 | 0.0               |
| ducta             | -   |  |  | -  | <del></del> -  |  |  |                   | ш  | ч   | т   | _                 |                                     | _                 | •                 |                   |                   |                   |
| 0.0               | 9   | TYP  | 68   | 50   | <u> </u>   | F F  |  | <b>T</b>          | 4C   | ŀ   | ŀ   |                   | -                                   | F                 | F                 | F                 | F                 | 0.0               |
| C.O               |   |  | 20   | 345  | }  |  |  | F                 | 4C   | F   | F   |                   |                                     | ŀ                 | F                 | 1                 | F                 | 0.0               |
| 0.0               | 1}  | TYP  | 68   | 68   |  | 54   |  | 24                | 78   | Ħ   | 69  | 9                 |                                     | F                 | ┞                 | 1                 | ╁                 | 0.0               |
| 0.0               |   |  | 20   | 455  | 1-   | 372  |  | 24                | 78   | Ţ   | 69  | 9                 |                                     | -                 | Ŀ                 |                   | Ţ                 | 0.0               |
| 0.04              | 0   | TYP  | 68   | 50   | 21   | <del>                                     </del>   |  |                   |  | _   |   | ᅥ                 |                                     | t                 | ┢                 | ļ. —              | +                 | 0.0               |
| 1                 | T   |  | 20   |  | 145  |  |  | _                 | _  | -   | _   |                   |                                     | T                 |                   | t                 | Ţ.                | 0.0               |
| 0,04              | 10  | TYP  |  |  | +  | 103  |  | _                 | _  | _   | 4   | $\exists$         | <del></del>                         | ⊢                 | <del>L</del>      | <del></del>       | t                 | 0.0               |
| 1                 | Ť   | Ť  | _  | +  | <u>-t                                    </u>  | $\rightarrow$  |  | _                 | _  | _   | -   | _                 |                                     | ╁╌                | 一                 | <del> </del>      | <del></del>       | 0.0               |
|                   | 1<br>26.4<br>0.08<br>2<br>2<br>2<br>0.08<br>2<br>4<br>0.04<br>1<br>1<br>0.08<br>2<br>2<br>0.08<br>2<br>2<br>0.08<br>2<br>1<br>0.08<br>1 | 1 20 26.4  0.08 0 2 0.08 0 2 thucts 0.04 0 1  0.08 75 2 0.08 0 2 ducts 0.0 0 0.0 0 0.0 0 | 1 20 TYP 26.4 0 TYP 26.4 0 TYP 2 0.08 0 TYP 2 1 1 0.08 75 TYP 2 0.08 0 TYP 2 0.08 0 TYP 2 0.08 0 TYP 2 0.08 0 TYP 2 0.00 0 TYP 6.6 0 TYP 0.0 0 TYP 0.0 0 TYP | 1 20 TYP 88 26.4 20 0.08 0 TYP 86 2 20 0.08 0 TYP 88 2 20 0.08 0 TYP 88 1 20 0.04 0 TYP 88 1 20 0.08 0 TYP 88 2 20 0.08 0 TYP 88 2 20 0.08 0 TYP 68 2 20 0.08 0 TYP 68 0.0 0 TYP 68 0.0 0 TYP 68 0.0 0 TYP 68 0.0 0 TYP 68 | 1 20 TYP 58 70 26.4 20 TYP 58 70 26.4 20 463  0.08 0 TYP 58 110 2 20 758 0.08 0 TYP 58 50 2 20 345 ducts 0.04 0 TYP 68 47 1 20 324  0.08 75 TYP 88 130 2 20 896 0.08 0 TYP 68 85 2 20 586 ducts 0.0 0 TYP 58 50 6.0 20 345 0.0 0 TYP 58 58 0.0 0 TYP 58 58 0.0 0 TYP 58 58 0.0 0 TYP 58 58 0.0 0 TYP 58 58 0.0 0 TYP 58 58 0.0 0 TYP 58 58 0.0 0 TYP 58 58 0.0 0 TYP 58 58 0.0 0 TYP 58 50 0.0 0 TYP 58 50 0.0 0 TYP 58 50 0.0 0 TYP 58 50 0.0 0 TYP 58 50 0.0 0 TYP 58 50 0.0 0 TYP 58 50 0.0 0 TYP 58 50 0.0 0 TYP 58 50 | 1 20 TYP 58 70 58 26.4 20 483 400  0.08 0 TYP 68 110 - 2 20 758 - 0.08 0 TYP 88 50 20  2 20 345 138  ducts 0.04 0 TYP 68 47 19 1 20 324 131  0.08 75 TYP 88 130 . 2 2 896 - 0.08 0 TYP 58 85 80 2 2 20 586 562  ducts 0.0 0 TYP 58 50 - 6.0 20 345 - 0.0 0 TYP 58 68 . 0.0 0 TYP 58 68 . 0.0 0 TYP 58 68 . 0.0 0 TYP 58 68 . 0.0 0 TYP 58 68 . 0.0 0 TYP 58 68 . 0.0 0 TYP 58 68 . 0.0 0 TYP 58 50 - 0.0 0 TYP 58 68 . 0.0 0 TYP 58 68 . 0.0 0 TYP 58 68 . 0.0 0 TYP 58 68 . 0.0 0 TYP 58 68 . 0.0 0 TYP 58 68 . | 1 20 TYP 68 70 58 - 26.4 20 483 400 - 20 483 400 - 20 483 400 - 20 6.5 2 20 758 - 20 758 758 758 758 758 758 758 758 758 758 | 1 20 TYP 88 70 58 | 1 20 TYP 68 70 58 25 26.4 20 483 400 - 25 26.4 20 483 400 - 25 27 28 20 758 - 3 29 20 758 - 3 20 345 138 - 58 20 20 345 138 - 58 21 20 345 138 - 58 21 20 324 131 - 44 20 324 131 - 3 20 324 131 - 3 21 20 896 - 3 22 20 896 - 3 23 20 896 - 3 24 20 896 - 3 25 20 896 - 3 26 20 896 - 3 27 20 896 - 3 28 20 896 - 3 38 35 80 | 1 20 TYP 88 70 58 - 2578 26.4 20 483 400 - 2578  0.08 0 TYP 88 110 3 - 3 - 2578  0.08 0 TYP 88 50 26 - 58 - 20 345 138 - 58 - 58 - 58 - 58 - 58 - 58 - 58 - | 1 20 TYP 88 70 58 2578 26.4 20 483 400 - 2578 26.4 20 483 400 - 2578 2578 2578 2578 2578 2578 2578 2578 | 1 20 TYP 58 70 58 | 1 20 TYP 88 70 58 - 2578 2578 254.4 | 1 20 TYP 88 70 58 | 1 20 TYP 88 70 88 | 1 20 TYP 88 70 58 | 1 20 TYP 88 70 58 | 1 20 TYP 88 70 58 |

<sup>\*</sup>Fatigue Strength: 100 x 10 <sup>6</sup>cycles, unless indicated as [N]X 10<sup>6</sup>.

Physical Properties

|                                  | US Customary                            | Metric  |
|----------------------------------|---|---|
| Melting Point - Liquidus         | 1920 F                                  | 1049 C  |
| Melting Point - Solidus          | 1750 F                                  | 954 C   |
| Density                          | 0.32 lb/in <sup>3</sup> at 68 F         | 8.86 gm/cm <sup>3</sup> @ 20 C                        |
| Specific Gravity                 | 8.86                                    | 8.86  |
| Electrical Resistivity           | 69.1 ohms-cmil/ft @ 68 F                | 11.49 microhm-cm @ 20 C                               |
| Electrical Conductivity*         | 15 %IACS @ 68 F                         | 0.088 MegaSiemens/cm @ 20 (                           |
| Thermal Conductivity             | 40.0 Btu - ft/(hr - ft2-oF)at 68F       | 69.2 W/m ⋅ °K at 20 C                                 |
| Coefficient of Thermal Expansior | 9.9 ·10 <sup>-6</sup> per °F (68-572 F) | 17.8 · 10 <sup>-6</sup> per <sup>o</sup> C (20-300 C) |
| Specific Heat Capacity           | 0.09 Btu/lb/ºF at 68 F                  | 377.1 J/kg - °K at 293 K                              |
| Modulas of Elasticity in Tension | 16000 ksi                               | 110000 MPa  |
| Modulus of Rigidity              | 6000 ksi                                | 41370 MPa   |

<sup>\*</sup>Determined on an alloy containing 5% tin and .2% phosphorus. This value will vary with the composition.

Tempers Most Commonly Used

| Flat Products |     |      |      |      |      |     |
|---------------|-----|------|------|------|------|-----|
| STRIP, ROLLED |     | H04, | H06, | H08, | H10, | O60 |
| WIRE, ROLLED  | H08 |      |      |      |      |     |

| Other  |                              |
|--------|------------------------------|
| ROD    | H02                          |
| SHAPES | SM30                         |
| TUBE   | H80                          |
| WIRE   | H00, H01, H02, H04, H06, H08 |

### Typical Uses

#### Architecture

**Bridge Bearing Plates** 

#### Electrical

Switch Parts, Electromechanical Spring Components, Resistance Wire, Electrical Flexing Contact Blades, Electrical Connectors. Electronic Connectors, Wire Brushes, Electronic and Precision Instrument Parts, Fuse Clips

#### **Fasteners**

Lock Washers, Fasteners, Cotter Pins

#### Industrial

Bellows, Textile Machinery. Perforated Sheets, Chemical Hardware, Truss Wire, Springs, Sleeve Bushings, Diaphragms, Clutch Disks, Bourdon Tubes, Beater Bar, Welding Rods, Pressure Responsive Elements

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### Copper Development Association

### Copperac

### Search Results

C63400 (Aluminum Bronze)

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           | Cu <sup>(1)</sup> |         |     |     |     | Ni <sup>(2)</sup> |         | Sn  |     |
|-----------|-------------------|---------|-----|-----|-----|-------------------|---------|-----|-----|
| Min./Max. | Rem.              | 2.6-3.2 | .09 | .15 | .05 | .15               | .25-,45 | .20 | .50 |
| Nominal   | 96.7              | 2.9     | _   | -   | -   |                   | .35     | -   |     |

- Cu value includes Ag.
- (2) Ni value includes Co.

Note: Cu + Sum of Named Elements, 99.5% min.

Applicable Specifications No information available.

Common Fabrication Processes

No information available.

Fabrication Properties No information available.

Mechanical Properties (measured at room temperature, 68 F (20 C) No information available.

Physical Properties No information available.

Tempers Most Commonly Used No information available.

Typical Uses
Electrical
Pole Line Hardware
Fasteners
Fasteners

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### Copperan

大型 可用原理 排送性 神体 表演話學地區 等 自体症 电多 在处理 折除管

### **Search Results**

C63600

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           | Си <sup>(1)</sup> А |         |     |     | ₽b  | Ni <sup>(2)</sup> | Si     | Sn  | Zπ  |
|-----------|---------------------|---------|-----|-----|-----|-------------------|--------|-----|-----|
| Min./Max. | Rem.                | 3.0-4.0 | .15 | .15 | .05 | .15               | .7-1.3 | .20 | .50 |
| Nominal   | 95.5                | 3.5     | -   | •   | - 1 | -                 | 1.0    | ļ   | -   |

(1) Cu value includes Ag.

(2) Ni value includes Co.

Note: Cu + Sum of Named Elements, 99.5% min.

Applicable Specifications No information available.

### **Common Fabrication Processes**

Cold heading

**Fabrication Properties** 

| Joining Technique              | Suitability     |
|--------------------------------|-----------------|
| Soldering                      | Not Recommended |
| Brazing                        | Not Recommended |
| Oxyacetylene Welding           | Not Recommended |
| Gas Shielded Arc Welding       | Fair            |
| Coated Metal Arc Welding       | Fair            |
| Spot Weld                      | Fair            |
| Seam Weld                      | Fair            |
| Butt Weld                      | Fair            |
| Capacity for Being Cold Worker | Excellent       |
| Capacity for Being Hot Formed  | Fair            |
| Machinability Rating           | 40              |

Mechanical Properties (measured at room temperature, 68 F (20 C)

| Temper | Section<br>Size | Cold<br>Work | Typ/<br>Min | Temp | Tenzile<br>Strength |     | Strength<br>(0.2% | Yleld<br>Strongth<br>(0.06%<br>offset) | Εì | Ra<br>Ha | ele<br>rdr | well<br>1086 | Vickens<br>Hard. | Brli<br>Har | nell<br>d. | Shear<br>Strongth | Fatigue<br>Strength | izod<br>Impact<br>Strength |
|--------|-----------------|--------------|-------------|------|---------------------|-----|-------------------|--|----|----------|------------|--------------|------------------|-------------|------------|-------------------|---------------------|----------------------------|
|        | n,              | %            |             | F    | kosi                | ķsi | ksi               | ksi .                                  | *  | В        | С          | 301          | 500              | 500         | 3000       | ksi               | ksi                 | ft⊣b                       |
|        | mm.             |              | Г           | c    | MPa                 | MPa | MPa               | MPa                                    | Г  | Г        | Π          |              |                  |             |            | MPa               | MPa                 | į.                         |
| Rod    |                 |              |             |      |                     |     |                   |  |    | _        |            | _            | •                |             |            |                   |                     |                            |

| 061  | 0.0   | b  | TYP | 68_ | 50  | <u> </u> | ŀ   | . F   | 64 | - 1 | <b>.</b> | ŀ | ŀ  | ı | L  | ŀ   | Į. | ŀ        | 0.0     |
|------|-------|----|-----|-----|-----|----------|-----|-------|----|-----|----------|---|----|---|----|-----|----|----------|---------|
|      | 0.0   | 1  |     | 20  | 414 | Ţ-       |     | Ţ     | 84 | П   | Ţ        | Ī | T  |   |    | Γ   | 1  | Ŧ        | 0.0     |
| Wire |       |    |     |     |     |          |     |       |    |     |          | • | _  |   |    |     |    |          |         |
| Hô1  | 0,488 | 21 | TYP | 68  | 84  | -        |     | . T-  | 29 | 34  | FF       | F | Ή. |   | ļ. | ŀ., |    | E        | 0.0     |
|      | 12.4  |    | T   | 20  | 570 | -        | Ţ.  | Ţ     | 29 | 84  | Ŧ        | F | 1  |   | -  | F   |    | T        | 0.0     |
| Rod  |       |    |     |     |     |          |     |       |    |     |          | • |    |   |    | _   | _  |          |         |
| H01  | 0.0   | C  | TYP | 38  | 74  | _}-      | F   | F     | 91 | - 1 | ĿF       | F | ŀ. |   | ·  | F   | F  | _ E      | <br>0.0 |
|      | 0.0   |    |     | 20  | 510 | Ţ        | 1   | _ I _ | 31 | -   | FF       | F | F  |   | Γ  | F   | -  | _        | 0.0     |
| Wire |       |    |     |     |     |          |     |       |    | _   |          | _ |    |   |    | _   |    |          |         |
| НО   | 0.422 | 7  | TYP | 68  | 68  | ŀ        | _ F | _ł    | 52 | 71  | ŀ        | F | F  |   | -  | ŀ   | F  | Ŀ        | <br>0.0 |
|      | 10.7  | Π. |     | 20  | 459 |          | -   | T     | 52 | 7 : | Ŧ        | Γ | L  |   |    | L   | T  | T        | 0.0     |
| C61  | 0.392 | Q  | TYP | 68_ | 60  |          |     |       | 67 |     | Ē        | F |    |   |    | F   | 1  | <u> </u> | 0,0     |
|      | 10    |    |     | 20  | 414 | -        | -   | F     | 67 | - 1 |          | F | F  |   |    |     | Ţ  | F        | 0.0     |

<sup>\*</sup>Fatigue Strength: 100 x 10 <sup>6</sup>cycles, unless indicated as [N]X 10<sup>6</sup>.

**Physical Properties** 

|                               | US Customary                                  | Metric                                   |
|-------------------------------|---|--|
| Melting Point - Liquidus      | 1890 F  | 1032 C                                   |
| Density                       | 0.301 lb/in <sup>3</sup> at 68 F              | 8.33 gm/cm <sup>3</sup> @ 20 C           |
| Specific Gravity              | 8.33  | 8.33                                     |
| Electrical Resistivity        | 86.4 ohms-cmil/ft @ 68 F                      | 14.36 microhm-cm @ 20 C                  |
| Electrical Conductivity       | 12 %IACS @ 68 F                               | 0.07 MegaSiemens/cm @ 20 C               |
| Thermal Conductivity          | 33.0 Btu · ft/(hr · ft2·°F)at 68              | 3F57.1 W/m · °K at 20 C                  |
| Coefficient of Thermal Expar  | ision 9.4 ·10 <sup>-6</sup> per °F (68-572 F) | 16.9 ·10 <sup>-6</sup> per °C (20-300 C) |
| Modulas of Elasticity in Tens | ion 16000 ksi                                 | 110000 MPa                               |

### Tempers Most Commonly Used

| Other |               |
|-------|---------------|
| ROD   | H01, O60      |
| WIRE  | H00, H01, O60 |

### **Typical Uses**

Electrical

Cold Headed Nuts, Cable Connectors, Components for Pole Line Hardware

**Fasteners** 

Screw Machine Products, Bolts

industrial

Valve Components, Nuclear Power Service

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### Copperons

### Search Results

C64200 (Aluminum Bronze)

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           | Cu <sup>(1)</sup> | Al      | As  | Fe  | Рb  | Mn | Ni <sup>(2)</sup> | Si      | Sn  | Zn  |
|-----------|-------------------|---------|-----|-----|-----|----|-------------------|---------|-----|-----|
| Min./Max. | Rem.              | 6.3-7.6 | .09 | .30 | .05 | 10 | .25               | 1.5-2.2 | .20 | .50 |
| Nominal   | 91.2              | 7.0     | 1   | _   |     |    | -                 | 1.8     | ,   | _   |

- (1) Cu value includes Ag.
- (2) Ni value includes Co.

Note: Cu + Sum of Named Elements, 99.5% min.

**Applicable Specifications** 

| Product         | Specification   |
|-----------------|---|
| Bar             | AMS 4631<br>ASME SB150<br>ASTM B150                   |
| Bar, Forging    | ASTM B124   |
| Bolts           | ASTM F468   |
| Forgings, Die   | AMS 4631<br>ASME SB283<br>ASTM B283                   |
| Nuts            | ASTM F467   |
| Rod             | AMS 4631<br>ASME SB150<br>ASTM B150<br>SAE J463, J461 |
| Rod, Forging    | ASTM B124   |
| Screws          | ASTM F468   |
| Shapes          | ASTM B150   |
| Shapes, Forging | ASTM B124   |
| Studs           | ASTM F468   |

Common Fabrication Processes Forging, Hot Forming, Machining

Fabrication Properties

| Joining Technique              | Suitability     |
|--------------------------------|-----------------|
| Soldering                      | Not Recommended |
| Brazing                        | Fair            |
| Oxyacetylene Welding           | Not Recommended |
| Gas Shielded Arc Welding       | Fair            |
| Coated Metal Arc Welding       | Fair            |
| Spot Weld                      | Fair            |
| Seam Weld                      | Fair            |
| Butt Weld                      | Fair            |
| Capacity for Being Cold Worked | Poor            |
| Capacity for Being Hot Formed  | Excellent       |
| Forgeability Rating            | 80              |
| Machinability Rating           | 60              |

321

379

58

400

38 262

241

Mechanical Properties (measured at room temperature, 68 F (20 C)

| Temper | Section<br>Size | Cold<br>Work | Typ/<br>Min | Temp | Tensile<br>Strength | Yield<br>Strength<br>(0.5% ext.<br>under load) | Strength<br>(0.2% | Yield<br>Strength<br>(0.05%<br>offset) | EJ | Ro<br>Ha |   |      |    | Vickens<br>Hard. | Brii<br>Har |      | Shear<br>Strongth | ratigue | izod<br>Impact<br>Strengti |
|--------|-----------------|--------------|-------------|------|---------------------|--|-------------------|--|----|----------|---|------|----|------------------|-------------|------|-------------------|---------|----------------------------|
|        | វា.             | 75           |             | F    | ksi                 | ksi  | icsi              | ksi                                    | Х  | В        | c | FBI  | 0T | 500              | 500         | 3000 | ksi               | cai     | n-t⊳                       |
|        | mm.             |              |             | c _  | MPa                 | MPa  | MPa               | MPa                                    | Г  | Г        | П | Т    |    | _                |             |      | MPa               | λiPa    | j.                         |
| Rod    |                 |              |             |      |                     |  |                   |  | _  | _        |   | _    |    |                  |             |      | •                 |         |                            |
| M30    | 0.75            | D .          | TYP         | 88   | 75                  | 35   |                   |  | 32 | 77       | F | - [- |    | -                | Γ.          |      | F                 | E       | 0.0                        |
|        | 19              |              |             | 20   | 517                 | 241  |                   | -                                      | 32 | 77       | F | -    |    | -                |             | F    | ļ-                | -       | 0,0                        |
| H04    | 1.5             | 10           | TYP         | 68   | 93                  | 60   |                   | - ·                                    | 28 | 90       | Ħ | +    |    |                  | ļ           |      |                   |         | 0.0                        |
|        | 38              |              |             | 20   | 641                 | 414  | -                 | -                                      | 20 | 90       | Г | -    |    | -                | -           | F    | -                 | -       | 0.0                        |
| H04    | 0.75            | 15           | ΓYΡ         | 68   | 102                 | 88   |                   |  | 22 | 94       | E | Ħ    |    | _                |             | F    | 59                | 50      | 0.0                        |
|        | 18              |              |             | 20   | 703                 | 469  | -                 |  | 22 | 94       | F | FF   |    |                  |             | F    | 407               | 345     | 0.0                        |

**Physical Properties** 

12.7

Forgings M10 2

|                                  | US Customary                             | Metric                                    |
|----------------------------------|--|---|
| Melting Point - Liquidus         | 1840 F                                   | 1004 C                                    |
| Melting Point - Solidus          | 1800 F                                   | 982 C                                     |
| Density                          | 0.278 lb/in <sup>3</sup> at 68 F         | 7.7 gm/cm <sup>3</sup> @ 20 C             |
| Specific Gravity                 | 7.69                                     | 7.69                                      |
| Electrical Resistivity           | 113.0 ohms-cmil/ft @ 68 F                | 18.79 microhm-cm @ 20 C                   |
| Electrical Conductivity          | 8 %IACS @ 68 F                           | 0.047 MegaSiemens/cm @ 20 C               |
| Thermal Conductivity             | 26.0 Btu - ft/(hr - ft2.ºF)at 68F        | 45.0 W/m - °K at 20 C                     |
| Coefficient of Thermal Expansion | 10.0 -10 <sup>-6</sup> per °F (68-572 F) | 18.0 · 10 <sup>-6</sup> per °C (20-300 C) |
| Specific Heat Capacity           | 0.09 Btu/lb/ºF at 68 F                   | 377.1 J/kg ⋅ ºK at 293 K                  |
| Modulas of Elasticity in Tension | 16000 ksi                                | 110000 MPa                                |
|                                  |  |   |

0,0

0.0

۵.۵

0.0

0.0

<sup>\*</sup>Fatigue Strength: 100 x 10 <sup>6</sup>cycles, unless indicated as [N]X 10<sup>6</sup>.

printed 06/01/2011 11:04AM by Luttie.Boarman p. 171/361

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Modulus of Rigidity

6000 ksi

41370 MPa

Tempers Most Commonly Used

Flat Products

BAR, DRAWN H04, H58, M30, O50

Other ROD

H04, M30, O50

SHAPESM30

Typical Uses

Automotive

Valve Guides, Automobile Engine

Electrical

Pole Line Hardware

**Fasteners** 

Bolts, Nuts

Industrial

Valve Components, Valve Bodies, Gears, Valve Stems, Cams

Marine

Hardware

Start Another Search

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### Search Results

C64900

Last Updated: Jul 06, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           | Cu <sup>(1)</sup> | ΑI  | Fe | Pb  | Ni <sup>(2)</sup> | Si    | Sn      | Żn  |
|-----------|-------------------|-----|----|-----|-------------------|-------|---------|-----|
| Min./Max. | Rem.              | .10 | 10 | .05 | 10                | 8-1.2 | 1.2-1.6 | .20 |
| Nominal   |                   | ·   | ,  | ı   | ŧ                 | 1.0   | 1.4     | 1   |

Cu value includes Ag.

(2) Ni value includes Co.

Note: Cu + Sum of Named Elements, 99.5% min.

Applicable Specifications No information available.

Common Fabrication Processes

No information available.

Fabrication Properties No information available.

Mechanical Properties (measured at room temperature, 68 F (20 C) No information available.

Physical Properties No information available.

Tempers Most Commonly Used No information available.

Typical Uses No information available.

Start Another Search

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7/9/2008



### Search Results

C65100 (Low-Silicon Bronze B)

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           | Cu <sup>(1)</sup> | Fe | Рb  | Mn | Si     | Zn  |
|-----------|-------------------|----|-----|----|--------|-----|
| Min./Max. | Rem.              | 8. | .05 | 7  | .8-2.0 | 1.5 |
| Nominal   | 98.5              | -  | -   | -  | 1.5    | - " |

(1) Cu value includes Ag.

Note: Cu + Sum of Named Elements, 99.5% min.

**Applicable Specifications** 

| TPDIIOGDIO  |                |
|-------------|----------------|
| Product     | Specification  |
| Bar         | ASME SB98      |
|             | ASTM B98       |
| Bolts       | ASTM F468      |
| Nuts        | ASTM F467      |
| Pipe        | ASTM B315      |
| Plate       | ASTM B96       |
| Plate, Clad | ASTM B432      |
| Rod         | ASME SB98      |
|             | ASTM B98       |
| Screws      | ASTM F468      |
| Shapes      | ASME SB98      |
|             | ASTM B98       |
| Sheet       | ASTM B96       |
| Strip       | ASTM B96       |
| Studs       | ASTM F468      |
| Tube        | ASTM B315      |
| Wire        | ASTM B99, B105 |

### **Common Fabrication Processes**

Forming and Bending, Heading and Upsetting, Hot Forging and Pressing, Roll Threading and Knurling, Squeezing and Swaging

|  | Fabrication | Properties |  |
|--|-------------|------------|--|
|--|-------------|------------|--|

| Joining Technique              | Suitability |
|--------------------------------|-------------|
| Soldering                      | Excellent   |
| Brazing                        | Excellent   |
| Oxyacetylene Welding           | Good        |
| Gas Shielded Arc Welding       | Excellent   |
| Coated Metal Arc Welding       | Fair        |
| Spot Weld                      | Excellent   |
| Seam Weld                      | Good        |
| Butt Weld                      | Excellent   |
| Capacity for Being Cold Worked | Excellent   |
| Capacity for Being Hot Formed  | Excellent   |
| Machinability Rating           | 30          |

| Mechanical Pro | perties ( | measured | at room | tempera | ture, i | 68 F ( | 20 C | ) |
|----------------|-----------|----------|---------|---------|---------|--------|------|---|
|                |           |          |         |         |         |        |      |   |

| Temper       |       |      | Typ/<br>Min | Temp   |     | Strength | Yleid<br>Strength<br>(0.2%                   | Yieid | _  | Ro  | cky  |                | Vickens  | Г        | nell<br>d. | Shear<br>Strength | Fatigue<br>Strength | izod<br>Impact<br>Strengti |
|--------------|-------|------|-------------|--------|-----|----------|--|-------|----|-----|------|----------------|----------|----------|------------|-------------------|---------------------|----------------------------|
|              | in,   | 74,  |             | F      | ksi | ksi      | ),si   | ksi   | Х  | В   | C F  | 301            | 500      | 500      | 3000       | ksi               | ksi                 | H4b                        |
|              | ດາກເຄ |      |             | i<br>O | MPa | MPa      | MPo  | MPa   | П  |     | П    |                |          |          |            | MPa               | MРа                 | Į.                         |
| Rod          |       |      |             |        |     |          |  |       |    |     | _    |                | •        |          |            |                   |                     |                            |
| D5035        | 1     | 0    | TYP         | 58     | 40  | 15       |  | -     | 50 |     | · la | \$             | F        | ŀ        | ŀ          | E                 | -                   | 0.0                        |
|              | 25.4  |      |             | 20     | 276 | 103      | -  | -     | 50 | - 1 | - 65 | <del>-</del> - | ļ —      | F        | F          | <u> </u> -        |                     | 0.0                        |
| Alim         |       |      | •           |        |     |          | <u> </u>                                     |       | _  |     |      | _              |          |          |            |                   |                     |                            |
| 106          | 0.08  | 0    | TYP         | 68     | 105 | 71       | <u>.                                    </u> |       | 10 | E   | ΕĒ   | F              |          | E.       | F          | 53                | 28                  | 0.0                        |
|              | 2     |      |             | 20     | 724 | 490      | -  |       | 10 | -   |      | F              | -        | F        | -          | 365               | 193                 | 0.0                        |
| Tube         |       |      |             |        |     |          |  |       |    |     |      |                |          |          |            |                   |                     |                            |
|              | 0.0   | 35   | TYP         | 68     | 65  | 40       | 1  | -     | 20 | 75  | ΕĿ   | 67             |          | E        | ŀ          | -                 |                     | 0.0                        |
|              | 0.0   |      |             | 20     | 448 | 276      | <u> </u>                                     | -     | 20 | 75  | ŀŀ   | 67             | -        | ŀ        | -          | -                 | -                   | 0.0                        |
| Rod          |       |      |             |        |     |          |  |       | _  |     | _    |                |          | •        |            |                   |                     |                            |
| H06          | 1     | 50   | ٤           | 68     | 90  | 67       | -  |       | 12 | 90  | ΞĒ   | <u>E.,</u>     | ŀ.       | Ł        | Ŀ          | 50                | -                   | 0.0_                       |
|              | 25,4  | L    |             | 20     | 621 | 462      | ŀ  | -     | 12 | 90  | ŀŀ   | ŀ              | -        | ŀ        | ŀ          | 345               | ŀ                   | 0.0                        |
| Nire         |       |      |             |        |     |          |  |       |    |     |      |                |          |          |            |                   |                     | •                          |
| HD4          | 0.44  | 60   | Ϋ́Р         | 68     | 95  |          | ·  |       | 12 |     | EE   | Ŀ              | -        | Ł        | <u> </u>   | <u> </u>          | -                   | 0,0                        |
|              | 11    | L. I | ·           | 20     | 855 | ·        | }  | -     | 12 | H   | ŀŀ   | ŀ              | -        | ŀ        | ŀ          | -                 | L-                  | 0.0                        |
| H01          | 0.08  | 0    | TYP         | 68     | 65  | 50       |  |       | 25 | -   | EE   | Ŧ              | }        | -        | -          | 40                |                     | 0.0                        |
|              | þ     |      |             | 20     | 448 | 345      | -  |       | 25 |     | FF   | F              | -        | Ι.       | 1          | 276               |                     | 0.0                        |
| H00          | 0.08  | o    | TYP         | 68     | 65  | 40       |  | -     | 40 | П   | Ħ    | F              | <b> </b> | F        | -          | 36                |                     | 0.0                        |
|              | 2     |      |             | 20     | 379 | 276      |  |       | 40 | -   | FF   | F              | -        |          |            | 248               | -                   | 0.0                        |
| Rod          |       |      |             |        |     |          |  |       | _  | _   |      | -              |          |          |            | h                 |                     |                            |
| HD4          | 1     | 36   | ΤΥΡ         | 88     | 70  | 55       | -  |       | 15 | 80  | ΕĒ   | F              |          | ŀ        | Į          | 45                | -                   | <b>0</b> .0                |
|              | 25.4  |      |             | 20     | 483 | 379      | <b>.</b>                                     | F     | 15 | 80  | F    | F              | -        | F        | F          | 310               | }                   | 0.0                        |
| Wire         |       |      |             |        |     |          |  |       |    |     |      |                |          |          |            |                   |                     |                            |
| H <b>0</b> 2 | 0.44  | 37   | TYP         | 68     | 80  |          | F  | -     | 20 | į.  | F E  | Ŀ              |          | <b>.</b> |            |                   | -                   | 0.0                        |
|              | 11    |      |             | 20     | 552 |          |  |       |    |     |      |                |          |          |            |                   |                     |                            |



## Copperate

**医抗毒素 医多种性 电电阻 机油油 机电阻 电电阻 医乳腺素 医性动脉** 

### **Search Results**

C65500 (High-Silicon Bronze A)

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|          | Cu <sup>(1)</sup> | Fe | Рb  | Mn      | Ni <sup>(2)</sup> | Si      | Zn  |
|----------|-------------------|----|-----|---------|-------------------|---------|-----|
| Min/Max. | Rem.              | 8  | .05 | .50-1.3 | .6                | 2.8-3.8 | 1.5 |
| Nominal  | 97.0              | ı  |     | .9      |                   | 3.0     | _   |

(1) Cu value includes Ag.

(2) Ni value includes Co.

Note: Cu + Sum of Named Elements, 99.5% min.

**Applicable Specifications** 

| Product                       | Specification                                |
|-------------------------------|--|
| Bar                           | SAE J463, J461                               |
| Bar, Forging                  | ASTM B124                                    |
| Bar, Rolled                   | ASME SB98<br>ASTM B96, B98<br>SAE J461, J463 |
| Bar, Rolled, Pressure Vessels | ASME SB96<br>ASTM B96                        |
| Bolts                         | ASTM F468                                    |
| Forgings, Die                 | ASTM B283                                    |
| Nuts                          | ASTM F467                                    |
| Pipe                          | ASME SB315<br>ASTM B315                      |
| Plate                         | ASME SB96<br>ASTM B96                        |
| Plate, Bridge and Bearing     | ASTM B100                                    |
| Plate, Clad                   | ASTM B432                                    |
| Plate, Pressure Vessels       | ASME S896<br>ASTM 896                        |
| Rod                           | ASME SB98<br>ASTM B98<br>SAE J461, J463      |
| Rod, Forging                  | ASTM B124                                    |

| Screws                    | ASTM F468                                      |
|---------------------------|--|
| Shapes                    | ASME SB98<br>ASTM B98<br>SAE J461, J463        |
| Shapes, Forging           | ASTM B124                                      |
| Sheet                     | ASME SB96<br>ASTM B96<br>SAE J461, J463        |
| Sheet, Bridge and Bearing | ASTM B100                                      |
| Sheet, Pressure Vessels   | ASME SB96<br>ASTM B96                          |
| Strip                     | ASME SB96<br>ASTM B96<br>SAE J461, J463        |
| Studs                     | ASTM F468                                      |
| Tube                      | ASME SB315<br>ASTM B315<br>MILITARY MIL-T-8231 |
| Wire                      | ASTM B105, B99                                 |

### **Common Fabrication Processes**

Blanking, Drawing, Forming and Bending, Heading and Upsetting, Hot Forging and Pressing, Roll Threading and Knurling. Shearing, Squeezing and Swaging

**Fabrication Properties** 

| Joining Technique              | Suitability |
|--------------------------------|-------------|
| Soldering                      | Good        |
| Brazing                        | Excellent   |
| Oxyacetylene Welding           | Good        |
| Gas Shielded Arc Welding       | Excellent   |
| Coated Metal Arc Welding       | Fair        |
| Spot Weld                      | Excellent   |
| Seam Weld                      | Excellent   |
| Butt Weld                      | Excellent   |
| Capacity for Being Cold Worked | Excellent   |
| Capacity for Being Hot Formed  | Excellent   |
| Forgeability Rating            | 40          |
| Machinability Rating           | 30          |

Mechanical Properties (measured at room temperature, 68 F (20 C)

| Temper   | Section<br>Size | Cold<br>Work | Typ/<br>Min | ?emp | Tensile<br>Strength | Strength | Strength<br>(0.2% | Yield<br>Strength<br>(0.05%<br>offsøt) | ΕI | Ro<br>Ha |      | veli<br>1935 |    | Vickens<br>Hard. | Brid<br>Har |      | Shear<br>Strongth | raugue<br>Strennih* | izod<br>Impact<br>Strength |
|----------|-----------------|--------------|-------------|------|---------------------|----------|-------------------|--|----|----------|------|--------------|----|------------------|-------------|------|-------------------|---------------------|----------------------------|
|          | и.              | %            | Г           | F    | ksi                 | ksi      | ksi               | ksi                                    | *  | 8        | d    | þ            | τÇ | 500              | 500         | 3000 | ksi               | ksi                 | ti-lb                      |
|          | mm.             |              |             | Ç    | MPa                 | MPa      | мРа               | MPa                                    | Г  |          | П    | T            | 1  |                  |             |      | MPa               | MPa                 | J                          |
| Flat Pro | ducts           |              |             |      |                     |          |                   |  |    |          |      |              |    |                  |             |      |                   |                     |                            |
| O\$015   | 0,04            | 0            | TΥΡ         | 86   | 63                  | 30       |                   |  | 55 | 86       | -  9 | 0            |    | _                | ŀ           | -    | 45                |                     | 0.0                        |
|          | 1               |              |             | 20   | 434                 | 207      | 1                 | -                                      | 55 | 56       | - 6  | 0            |    | _                | -           | ŀ    | 310               |                     | <b>9.0</b>                 |
| 102      | 0.04            | c            | TYP         | 68   | 78                  | 45       |                   |  | 17 | 37       | F    | 75           | 5  | -                |             | F    | 50                | -                   | 0.0                        |
|          | 1               |              |             | 20   | 538                 | 310      |                   | _                                      | 17 | 87       | H    | 75           | 5  |                  | -           | -    | 345               | -                   | 0.0                        |
| Rod      |                 |              |             |      |                     |          |                   |  |    |          |      |              | _  |                  |             |      | <u> </u>          |                     |                            |
| H06      | 1               | 50           | TYP         | 68   | 108                 | 60       | _                 |  | 13 | 95       | F    | Ŀ            |    | اشيح             | L           | F    | <b>32</b>         | F                   | 0.0                        |
|          | 25.4            |              |             | 20   | 745                 | 414      |                   | -                                      | 13 | 95       | ŀŀ   | F            |    |                  | -           | -    | 427               | -                   | <b>3.0</b>                 |

| Wire         |          |    |            |           |                |         |                  |              |               |            |            |                  |  |          |  | _               |  |      |
|--------------|----------|----|------------|-----------|----------------|---------|------------------|--------------|---------------|------------|------------|------------------|--|----------|--|-----------------|--|------|
| 101          | 0.08     | 0  | ΓÝΡ        | 68        | 80             | 48      |                  |              | 20            | F          | ì          |                  | }  | _        | F  | 52              | F  | 0,0  |
|              | þ        |    |            | 20        | 552            | 331     | <u></u>          |              | 20            | F          |            |                  | }  | -        | F -  | 359             | F -  | 0.0  |
| 00           | 0.08     | Ö  | TYP        | 68        | 70             | 40      | · _              | ,            | 35            | F          |            |                  | F  |          | Ŀ  | 48              | 1  | 0.0  |
|              | 2        | T  |            | 20        | 483            | 276     | -                | -            | 35            | F          |            |                  |  | F        | ļ  | 337             | T  | 0,0  |
| lat Pr       | oducts   |    |            |           |                |         |                  |              |               | _          |            |                  |  | _        |  | -               | •  |      |
| S035         | Q.04     | 0  | TYP        | <b>38</b> | 50             | 25      | ŀ                | ŀ            | 606           | <b>2</b> - | 85         |                  | ŀ  | ŀ        | ŀ.   | 43              | F  | 0.0  |
|              | 1        |    |            | 20        | 414            | 172     | <b>—</b>         | Ŀ            | 606           | 4          | 85         |                  |  |          | ļ.   | 2 <del>96</del> | T.   | 0.0  |
| 106          | 0.04     | 0  | ТҮР        | 68        | 104            | 60      | +                | ╁            | 6 9           | -          |            | 80               | _  | F        | ţ  | 60              | +  | 0.0  |
|              | h        |    | T          | 20        | 717            | 414     |                  |              |               | s I        |            | 30               |  |          |  | 414             |  | 0.0  |
| ube          |          | _  | ٠          |           | _              |         |                  |              | 1. 1.         | يت         | Ш          | -                | <b>'</b>   | _        | _  | r.,,            | ٠  |      |
| ieo          | 0.065    | 35 | TYP        | 38        | 93             | Ţ       | T.               | -            | 229           | э.         | П          | 76               | <u>.                                      </u>   | L        | L.   | F               | Ţ  | 0,0  |
|              | 1.7      | Ŧ  | T          | 20        | 641            | 1.      |                  |              | 229:          | _          |            | a                | t  | t        | t  |                 | 1 -  | 0.0  |
| íat Pr       | oducts   |    | ٠          |           |                |         |                  | -            | <u> </u>      | l          |            |                  | <u> </u>   | <u> </u> | Ц  | <u> </u>        | <u> </u>   | P.** |
| 104          | 0.04     | ю  | TYP        | 88        | <del>9</del> 4 | 58      | F                | -            | 8 9:          | 34.        |            | 78               |  | Γ        | ļ.   | 57              | <b>-</b>   | 0.0  |
|              | 1        | 1  | _          | 20        | 648            | 400     | 1                | $\top$       | 8 9:          | -          | _          | 78               |  | E        | t  | 393             | <del>1</del>                                     | 0.0  |
| 108          | 0.04     | 0  | TYP        |           | 110            | 62      | <del>-</del> -   | -            | 4 9           | _          |            | 81               | <del>                                     </del> | $\vdash$ | $\vdash$                                     | 63              | <del></del>                                      | 0.0  |
| 100          | 1,07     | Ť  | _          | 20        | 758            | 427     | <del>- [ -</del> | ╅            | $\rightarrow$ | -          |            | _                | <del></del>                                      | H        | -  | •               | +  | _    |
|              | <u> </u> | ٠  | 1          | 20        | 126            | 427     |                  |              | 4 9           | Щ          | _          | <b>91</b>        |  | <u> </u> | <u> </u>                                     | 434             | <u> </u>   | 0.0  |
| Rod<br>05050 | k        | 0  | TYP        | E o       | 58             | 22      |                  | _            | lankı         | J          | _          |                  |  | _        | τ –  | Teo             | -  | la a |
| X3V3V        |          | ř  | 1          |           | _              | _       | +                | ┿-           | 608           | -          | Н          | Ï                | <b></b>  | ┝        | ┡  | 43              | +  | 0.0  |
|              | 25.4     | 4  | _          | 20        | 400            | 152     | <u> </u>         | ┸—           | 50B(          | _          | Ц          |                  | <u> </u>   | Ŀ,       | <u> </u>                                     | 296             | <u> </u>   | 0.0  |
| 104          | <u> </u> | 36 | TYP        | _         | 92             | 55      |                  | +            | 2290          | 靯          | L          |                  | <u> </u>   | Ŀ        | <u> </u>                                     | 58              | <b>ᅷ</b>   | 0,0  |
|              | 25.4     |    |            | 20        | 634            | 379     | +                |              | 2230          | Ł          | -          |                  |  |          | <u>t                                    </u> | 400             | <u> </u>   | 0.0  |
| Vire         | 1        | -  |            |           |                | -       |                  |              |               | _          | _          |                  |  |          |  |                 |  |      |
| 108          | 0.0B     | 0  | ΤÝΡ        | _         | 145            | 70      | <del>-</del>     | <del>-</del> | 3 }           | Ł          | 니          | _                |  | Ŀ        | <u> </u>                                     | 70              | 30   | 0.0  |
|              | 2        | 4  |            | 20        | 1000           | 483     |                  | <u> </u>     | 3 -           | Ł          | L          | -                |  | Ŀ.       | <u> </u>                                     | 483             | 207  | 0.0  |
|              | oducts   |    |            | ,         |                |         |                  |              |               | _          | _          |                  |  |          |  |                 |  |      |
| )S070        | 0.04     | 0  | TYP        | į         | 56             | 21      | <u> </u>         | _            | 6340          | Ł          | 7 <i>6</i> | -                |  | <u> </u> | Ŀ  | 42              |  | 0.0  |
|              | 1        |    |            | 20        | 386            | _ 145 _ | <u> </u>         |              | 8344          | Ŋ-]        | 76         | -                | -  | ŀ        | ŀ  | 290             | F  | 0.0  |
| łod          |          |    |            |           |                |         |                  |              |               |            |            |                  |  |          |  |                 |  |      |
| 102          | 1        | 20 | ĨΫ́Р       | _         | 78             | 45      |                  |              | 3589          | E          | Ц          |                  | ,  |          | Ŀ  | 52              | -  | 0.0  |
|              | 25.4     | 1  |            | 20        | 538            | 310     | +                | ŀ            | 35/8          | 5-         | ⊦          | -                | ŀ  | -        | ┞  | 359             | ŀ  | 0.0  |
| Vire         |          |    |            |           |                |         |                  |              |               |            |            |                  |  |          |  |                 |  |      |
| )S035        | 80.0     | þ  | TYP        | 68        | 60             | 25      |                  | <u> </u>     | <b>30</b> -   | Ŀ          |            |                  | +  |          | Γ  | 43              | -  | 0.0  |
|              | 2        | L  | <u>L</u> . | 20        | 414            | 172     | _ }              | } <u> </u>   | 60            | -          | ŀ          | - ]              | -  | ┡        | ┡  | 296             | 1  | 0.0  |
| 104          | 0.08     | D  | ТҮР        | 6R        | 125            | 65      | Ŀ                | Ŀ            | 5-            | Ħ          |            | -                | -  | E        | E  | 65              | 29   | 0.0  |
|              | 2        |    |            | 20        | 862            | 448     | T                | -            | 5 -           | П          | П          | -                |  | F        | ļ.   | 448             | 200  | 0.0  |
| ube          |          | -  | •          |           |                |         |                  |              |               |            | _          |                  |  |          |  | ·               |  |      |
| S050         | 0.065    | 0  | TYP        | 68        | 57             | _ F     | Ŧ                | Ŧ            | 7045          | F          | П          |                  | - 1  | į.       | F  | F               | Į.   | 0.0  |
|              | 1.7      |    |            | 20        | 393            | T-      | 1                |              | 7049          | -          | .          |                  |  |          | I  |                 | 1  | 0.0  |
| Yire         |          |    |            |           |                |         |                  |              | ثلت ا         |            | ш          |                  |  | <u> </u> |  | <u> </u>        | —  |      |
| 102          | 80.0     | 0  | τγp        | 68        | 98             | 57      | F                | 1            | 8 -           | ŢĪ         | П          |                  |  |          | Ţ.   | 58              | T  | 0.0  |
|              | 2        | 1  | -          | 20        | 676            | 393     | 1                | 1            | f.t           | Ħ          | H          |                  |  | t        | t  | 400             | <del></del>                                      | 0.0  |
| ist D-       | oducts   |    |            | С.        |                |         | <u> </u>         |              | <u> </u>      | Ц          | [          |                  |  |          | <u> </u>                                     | 700             | <u> </u>   | ۳.۷  |
| 101          | 0.04     | 0  | TYP        | S.A       | 68             | 35      | τ –              | ı            | 3079          |            | 7          | 67               |  |          |  | 47              |  | 0.0  |
|              | 1        | Ť  | _          | 8         | 469            | 241     | ┰                | <del></del>  | 3079          |            | -          | 9 <i>1</i><br>67 |  |          | ੁ  | 324             | <del>f                                    </del> | 0.0  |
|              |          |    |            | e u       | <b>11</b> 6754 | #/#T    |                  |              |               |            |            |                  |  |          |  |                 |  |      |

<sup>\*</sup>Fatigue Strength: 100 x 10 <sup>6</sup>cycles, unless indicated as [N]X 10<sup>6</sup>.

### **Physical Properties**

|                          | US Customary                     | Metric                         |
|--------------------------|----------------------------------|--------------------------------|
| Melting Point - Liquidus | 1880 F                           | 1027 C                         |
| Melting Point - Solidus  | 1780 F                           | 971 C                          |
| Density                  | 0.308 lb/in <sup>3</sup> at 68 F | 8.53 gm/cm <sup>3</sup> @ 20 C |
| Specific Gravity         | 8.53                             | 8.53                           |
| Electrical Resistivity   | 148.0 ohms-cmil/ft @ 68 F        | 24.6 microhm-cm @ 20 C         |
| Electrical Conductivity  | 7 %IACS @ 68 F                   | 0.041 MegaSiemens/cm @ 20 C    |
| Thermal Conductivity     | 21.0 Btu · ft/(hr · ft2·ºF)at 68 | F36.3 W/m · °K at 20 C         |

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| Coefficient of Thermal Expansion | 10.0 ·10 <sup>-6</sup> per °F (68-572 F) | 18.0 · 10 <sup>-6</sup> per °C (20-300 C) |
|----------------------------------|--|---|
| Specific Heat Capacity           | 0.09 Stu/lb/ºF at 68 F                   | 377.1 J/kg · °K at 293 K                  |
| Modulas of Elasticity in Tension | 15000 ksi                                | 103400 MPa                                |
| Modulus of Rigidity              | 5600 ksi                                 | 38610 MPa                                 |

**Tempers Most Commonly Used** 

| Flat Products |  |
|---------------|--|
| PLATE         | M20  |
| SHEET         | M20  |
| STRIP, ROLLED | H01, H02, H04, H06, H08, OS015, OS035, OS070 |
| WIRE, ROLLED  | H02, H06                                     |

| Other | · · · · · · · · · · · · · · · · · · · |           |
|-------|---------------------------------------|-----------|
|       | H02, H04, H06, OS050                  |           |
| TUBE  | H58, H80, OS050                       |           |
| WIRE  | H00, H01, H02, H04, H08, OS0          | 15, OS035 |

### Typical Uses

Consumer

Sculpture

Electrical

Pole Line Hardware, Motors, Rotor Bar

**Fasteners** 

Screws, Rivets, Burrs, Nuts, Nails, Cotter Pins, Clamps, Bolts, Hinges

Industrial

Screen Cloth, Wear Plates, Screen Plates, Shafting, Wire. Welded Pressure Vessels, Oil Refinery Plumbing Tube, Bearing Plates, Butts, Bushings, Cable, Channels, Chemical Equipment, Heat Exchanger Tubes, Kettles, Hydraulic Pressure Lines, Tanks, Piston Rings, Doctor Blades, Paper Industry, Pressure Vessels, Welded Tanks

Marine

Hardware, Propeller Shafts

Start Another Search

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### Copperme

THE DEPOSIT OF THE PROPERTY OF

### **Search Results**

C65600

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|          | Cu <sup>(1)</sup> | ΑĬ  | Fe  | Рb  | Mn  | Si      | Sn  | Zn  |
|----------|-------------------|-----|-----|-----|-----|---------|-----|-----|
| Min/Max. | Rem.              | .01 | .50 | .02 | 1.5 | 2.8-4.0 | 1.5 | 1.5 |
| Nominal  | 96.6              |     | -   |     | -   | 3.4     | -   | -   |

(1) Cu value insludes Ag.

Note: Cu + Sum of Named Elements, 99.5% min.

Applicable Specifications

| Product            | Specification   |
|--------------------|-----------------|
| Electrode, Welding | AWS A5.6        |
| Rod, Welding       | AWS A5.27, A5.7 |

### Common Fabrication Processes

Welding

Fabrication Properties No information available.

Mechanical Properties (measured at room temperature, 68 F (20 C) No information available.

Physical Properties No information available.

Tempers Most Commonly Used No information available.

Typical Uses Industrial Welding Rod, Filler Metal

Start Another Search

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### Copperen

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### **Search Results**

C67300

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           | Cu <sup>(1)</sup> | ΑI  | Fe  | Pb     | Mn      | Ni <sup>(2)</sup> | Si      | Sn  | Zn   |
|-----------|-------------------|-----|-----|--------|---------|-------------------|---------|-----|------|
| Min./Max. | 58.0-63.0         | .25 | .50 | 40-3.0 | 2.0-3.5 | .25               | .50-1.5 | .30 | Rem. |
| Nominal   | 60.5              | 1   |     | 1.7    | 2.7     | -                 | 1.0     | ,   | 34.1 |

- (1) Cu value includes Ag.
- (2) Ni value includes Co.

Note: Cu + Sum of Named Elements, 99.5% min.

**Applicable Specifications** 

| Product  | Specification  |
|----------|----------------|
| Bar      | SAE J461, J463 |
| Forgings | SAE J461, J463 |
| Rod      | SAE J463, J461 |
| Shapes   | SAE J463, J461 |

#### **Common Fabrication Processes**

Hot Forming, Hot Pressing, Machining

**Fabrication Properties** 

Joining Technique Suitability
Machinability Rating 70

Mechanical Properties (measured at room temperature, 68 F (20 C)

| Temper | Section<br>Sire | Cold<br>Work | Typ/<br>Min | Тегър | Tensite<br>Strength |     | Strength<br>(0.2% | Yleid<br>Strength<br>(0.05%<br>offset) | Ef  | Ro<br>Ha | eck<br>rd | well<br>ness | Vickens<br>Hard. | Har<br>Bris | neli<br>d. | Shear<br>Strangth | Landae   | izod<br>impact<br>Strength |
|--------|-----------------|--------------|-------------|-------|---------------------|-----|-------------------|--|-----|----------|-----------|--------------|------------------|-------------|------------|-------------------|----------|----------------------------|
|        | in              | %            |             | 뜨     | ksi                 | ksi | kæi               | kal                                    | %   | В        | þ         | 301          | 500              | 500         | 3000       | ksi :             | ksi .    | n-ip                       |
|        | mm,             |              |             | С     | MPa                 | MРa | MPa               | MРа                                    | Г   |          | П         | Т            |                  |             |            | MPa               | MPa      | ļ                          |
| Bar    |                 |              |             |       |                     |     |                   |  |     |          | _         |              |                  |             |            |                   | -        |                            |
| H50    | <1.00           | 0            | min         | 88    | 65                  | 40  |                   |  | : 1 | 80       | F         | Ŀ            | -                |             | F          | - 1               | -        | 0.0                        |
|        | <25 4           |              |             | 20    | 448                 | 276 |                   | -                                      | 11  | ŝŪ       | IJ        | 1            |                  | Ł.          | F          |                   | <u> </u> | 0.0                        |

<sup>\*</sup>Fatigue Strength: 100 x 10 6cycles,

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unless indicated as [N]X 106.

**Physical Properties** 

|                                | US Customary  | Metric                                   |
|--------------------------------|---|--|
| Melting Point - Liquidus       | 1605 F  | 874 C                                    |
| Density                        | 0.3 lb/in <sup>3</sup> at 68 F                            | 8.3 gm/cm <sup>3</sup> @ 20 C            |
| Specific Gravity               | 8.3   | 8.3                                      |
| Electrical Conductivity        | 22 %IACS @ 68 F   | 0.13 MegaSiemens/cm @ 20 C               |
| Thermal Conductivity           | 55.0 Btu - ft/(hr - ft2-9F)at 68F                         |  |
| Coefficient of Thermal Expan   | sion 11.0 ·10 <sup>-6</sup> per <sup>o</sup> F (68-572 F) | 19.0 ·10 <sup>-6</sup> per °C (20-300 C) |
| Modulas of Elasticity in Tensi | on 17000 ksi  | 117200 MPa                               |

#### **Tempers Most Commonly Used**

| Other        |     |
|--------------|-----|
| BAR          | H50 |
| <b>FORGS</b> | T   |
| ROD          | H50 |

### Typical Uses

**Fasteners** 

Fasteners, Lead Screw Nuts

Industrial

Clutch Bearings, Shaft Bushings, Propeller Shafts, Sleeve Bearings, Thrust Bearings, Pump Parts, Seal Rings, Spindles, Idler Pins, Drive Shafts, Piston Heads, Bearings, Bushings, Bearings, Pins, Wear Plates, Gears and Cams

Marine

Hardware, Valve Seats

Other

Connecting Rods

Start Another Search

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### Copperan

()连查10元;从10多4分单位的第三位,20多元时间,10分元

### Search Results

C67500 (Manganese Bronze A)

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           | Cu <sup>(1)</sup> | ΑI  | Fe     | Pb  | Mn    | Sn      | Żn   |
|-----------|-------------------|-----|--------|-----|-------|---------|------|
| Min./Max. | <b>57.0-60.</b> 0 | .25 | .8-2.0 | .20 | .0550 | .50-1.5 | Rem. |
| Nominal   | 58.5              | -   | 1.4    | ,   | .10   | 1.0     | 39.0 |

(1) Cu value includes Ag.

Note: Cu + Sum of Named Elements, 99.5% min.

**Applicable Specifications** 

| Product         | Specification               |
|-----------------|-----------------------------|
| Ваг             | ASTM B138<br>SAE J461, J463 |
| Bar, Forging    | ASTM B124                   |
| Bolts           | ASTM F468                   |
| Forgings, Die   | ASTM B283<br>SAE J463, J461 |
| Nuts            | ASTM F467                   |
| Rod             | ASTM B138<br>SAE J463, J461 |
| Rod, Forging    | ASTM B124                   |
| Screws          | ASTM F468                   |
| Shapes          | ASTM B138<br>SAE J461, J463 |
| Shapes, Forging | ASTM B124                   |
| Studs           | ASTM F468                   |

#### **Common Fabrication Processes**

Hot Forging and Pressing, Hot heading and upsetting

**Fabrication Properties** 

| Joining Technique | Suitability |
|-------------------|-------------|
| Soldering         | Excellent   |
| Brazing           | Excellent   |
|                   |             |

| Oxyacetylene Welding           | Good            |
|--------------------------------|-----------------|
| Gas Shielded Arc Welding       | Fair            |
| Coated Metal Arc Welding       | Not Recommended |
| Spot Weld                      | Good            |
| Seam Weld                      | Fair            |
| Butt Weld                      | Good            |
| Capacity for Being Cold Worked | Poor            |
| Capacity for Being Hot Formed  | Excellent       |
| Forgeability Rating            | 80              |
| Machinability Rating           | 30              |

Mechanical Properties (measured at room temperature, 68 F (20 C)

| Temper | <b>}</b> | Cold<br>Work | Typ/<br>Min | Temp   | Tensile<br>Strength | Strength | Strength<br>(0.2% | Yieid<br>Strength<br>(0.05%<br>offset) | Ei | Ro<br>His | oc li<br>ard | well<br>ness | Vickens<br>Hard. | Brit<br>Har | reil<br>d. | Shear<br>Strength | Ctennusp, | Izod<br>Impact<br>Strengti |
|--------|----------|--------------|-------------|--------|---------------------|----------|-------------------|--|----|-----------|--------------|--------------|------------------|-------------|------------|-------------------|-----------|----------------------------|
|        |          | %            |             | F      | ksi                 | ksi      | ksi               | ksi                                    | χ, | 9         | c            | F301         | 500              | 500         | 3000       | ksi               | ksi       | R√b                        |
|        | mm.      |              |             | С      | MPa                 | MPa      | MPa               | MPa                                    |    | Π         | П            |              |                  |             |            | MPe               | MPa       | ı,                         |
| Rod    |          |              |             |        |                     |          |                   |  |    |           |              |              |                  |             |            |                   |           |                            |
| HQ1    | 2        | 10           | TYP         | 68<br> | 72                  | 42       | _                 |  | 27 | 77        | E            | ·ŀ           | F                | ·           |            | 44                | ·         | 0.0                        |
|        | 51       |              |             | 20     | 496                 | 290      |                   | -                                      | 27 | 77        | Fl           |              | F -              | ŀ           |            | 303               | -         | 0,0                        |
| O60    | 1        | 0            | TYP         | 68     | 65                  | 30       |                   |  | 33 | В:        | Ŀ            | L            | -                | Ŀ           |            | 42                | -         | 0.0                        |
|        | 25.4     |              |             | 20     | 44B                 | 207      | -                 |  | 33 | 65        | F            |              | -                | ŀ           | -          | 290               | -         | 0.0                        |
| H02    | t        | 20           | TYP         | 68     | <del>84</del>       | 60       |                   | -                                      | 19 | ЭÇ        | Ē            |              | -                |             | ,          | 48                |           | 0.0                        |
|        | 25.4     |              |             | 20     | 579                 | 414      | -                 | -                                      | 19 | þс        | П            |              | J. —             | F           | L          | 331               | -         | 0.0                        |
| H01    | 1        | 10           | ΓYΡ         | GB     | 77                  | 45       |                   |  | 23 | 83        | Ł            |              | Ē                |             | F          | 47                |           | 0.0                        |
|        | 25.4     |              |             | 20     | 531                 | 310      |                   |  | 23 | a         | П            | .  -         | -                |             |            | 324               |           | 0.0                        |

<sup>\*</sup>Fatigue Strength: 100 x 10  $^6$ cycles, unless indicated as [N]X 10 $^6$ .

Physical Properties

|                                  | US Customary                             | Metric                                   |
|----------------------------------|--|--|
| Melting Point - Liquidus         | 1630 F                                   | 888 C                                    |
| Melting Point - Solidus          | 1590 F                                   | 866 C                                    |
| Density                          | 0.302 lb/in <sup>3</sup> at 68 F         | 8.36 gm/cm³ @ 20 C                       |
| Specific Gravity                 | 8.36                                     | 8.36                                     |
| Electrical Resistivity           | 43.2 ohms-cmil/ft @ 68 F                 | 7.18 microhm-cm @ 20 C                   |
| Electrical Conductivity          | 24 %IACS @ 68 F                          | 0.14 MegaSiemens/cm @ 20 C               |
| Thermal Conductivity             | 61.0 Btu · ft/(hr · ft2·°F)at 68F        | 105.6 W/m - ºK at 20 C                   |
| Coefficient of Thermal Expansion | 11.8 ·10 <sup>-6</sup> per °F (68-572 F) | 21.2 ·10 <sup>-6</sup> per °C (20-300 C) |
| Specific Heat Capacity           | 0.09 Btu/lb/ºF at 68 F                   | 377.1 J/kg ⋅ ºK at 293 K                 |
| Modulas of Elasticity in Tension | 15000 ksi                                | 103400 MPa                               |
| Modulus of Rigidity              | 5600 ksi                                 | 38610 MPa                                |

### **Tempers Most Commonly Used**

| Other  |      |      |      |     |
|--------|------|------|------|-----|
| ROD    | H01, | H02, | M30, | O60 |
| SHAPES | M30  |      |      |     |

Typical Uses Automotive

Clutch Disks, Shafting, Pump Rods

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| F | a | s | t | e | n | 6 | rē |  |
|---|---|---|---|---|---|---|----|--|
|---|---|---|---|---|---|---|----|--|

Bolts

Industrial

Valve Bodies, Balls, Valve Stems, Bushings, Aircraft Parts

Marine

Hardware

Start Another Search

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### Copperm

### Search Results

C69400 (Silicon Red Brass)

Last Updated: Apr 28, 2008

### **Chemical Composition**

(%max., unless shown as range or min.)

|           | Cu <sup>(1)</sup>  | Fe | Pb  | Si      | Zn   |
|-----------|--------------------|----|-----|---------|------|
| Min./Max. | 80.0 <b>-8</b> 3.0 | 20 | .30 | 3.5-4.5 | Rem. |
| Nominal   | 81.5               | ,  | •   | 4.0     | 14.5 |

(1) Cu value includes Ag.

Note: Cu + Sum of Named Elements, 99.5% min.

#### **Applicable Specifications**

| Product | Specification |
|---------|---------------|
| Rod     | ASTM B371     |

### **Common Fabrication Processes**

Forging, Screw Machining

**Fabrication Properties** 

| Joining Technique              | Suitability |
|--------------------------------|-------------|
| Soldering                      | Excellent   |
| Brazing                        | Excellent   |
| Oxyacetylene Welding           | Good        |
|                                | Good        |
|                                | Good        |
| Butt Weld                      | Good        |
| Capacity for Being Cold Worked |             |
| Capacity for Being Hot Formed  | Excellent   |
| Forgeability Rating            | 80          |
| Machinability Rating           | 30          |

Mechanical Properties (measured at room temperature, 68 F (20 C)

| Temper | Section<br>Size | Cold<br>Work | Typ/<br>Min | Temp | Tonallo | Strength | Strength<br>(0.2% | Yield<br>Strength<br>(0,05%<br>offset) | ΕI | R ( | e k     | well<br>ness | Vickens<br>Herd. | Bri<br>Ha | nell<br>rd. | Shoar<br>Strangth | Fatigue<br>Strength* | izod<br>Impact<br>Strength |
|--------|-----------------|--------------|-------------|------|---------|----------|-------------------|--|----|-----|---------|--------------|------------------|-----------|-------------|-------------------|----------------------|----------------------------|
|        | in.             | ě            |             | ĮL,  | ksi     | ksi      | ksi .             | ksi                                    | *  | B   | c       | 301          | 500              | 501       | 3000        | ksi               | ksi                  | fi-lb                      |
|        | mm.             |              |             | C    | MPa     | MPa      | мРа               | MPa                                    |    |     | $\prod$ |              |                  |           |             | MPa               | MPa                  | j                          |

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| Rod |      |   |     |    |     |     |   |        |       |
|-----|------|---|-----|----|-----|-----|---|--------|-------|
| O60 | 2    | О | TYP | 68 | 80  | 40  |   | 26 95- | - 0.0 |
|     | 51   |   |     | 20 | 552 | 278 | _ | 25 95  | D.0   |
| H00 | 0.76 | 0 | TYP | 68 | 100 | 67  |   | 21 95  | - 0.0 |
|     | 19   |   |     | 20 | 889 | 393 | 1 | 2195   | - 0,0 |
| 060 | 0.5  | 6 | TYP | 68 | 90  | 45  |   | 2085   | 0.0   |
|     | 12.7 |   |     | 20 | 621 | 310 | , | 20 85  | 0.0   |
| 080 | 1    | 0 | TYP | 68 | 85  | 43  | - | 25 85  | 0.0   |
|     | 25 4 | T |     | 20 | 586 | 296 | 1 | 25 85  | - 0.0 |

\*Fatigue Strength: 100 x 10 6cycles, unless indicated as [N]X 10<sup>6</sup>.

Physical Properties

|                                  | US Customary                                | Metric                                   |
|----------------------------------|---|--|
| Melting Point - Liquidus         | 1685 F                                      | 918 C                                    |
| Melting Point - Solidus          | 1510 F                                      | 821 C                                    |
| Density                          | 0.296 lb/in <sup>3</sup> at 68 F            | 8.19 gm/cm <sup>3</sup> @ 20 C           |
| Specific Gravity                 | 8.19  | 8.19                                     |
| Electrical Resistivity           | 167.0 ohms-cmil/ft @ 68 F                   | 27.76 microhm-cm @ 20 C                  |
| Electrical Conductivity          | 6 %IACS @ 68 F                              | 0.036 MegaSiemens/cm @ 20 C              |
| Thermal Conductivity             | 15.0 Btu · ft/(hr · ft2.0F)at 68F           | 26.0 W/m · ºK at 20 C                    |
| Coefficient of Thermal Expansio  | п 11.2 · 10 <sup>-5</sup> per °F (68-572 F) | 20.2 ·10 <sup>-6</sup> per °C (20-300 C) |
| Specific Heat Capacity           | 0.09 Btu/lb/ºF at 68 F                      | 377.1 J/kg · ºK at 293 K                 |
| Modulas of Elasticity in Tension | 16000 ksi                                   | 110000 MPa                               |

**Tempers Most Commonly Used** 

Other RODH00, 060

**Typical Uses** Industrial Valve Stems

Start Another Search

### **DISCLAIMER:**

The values listed above represent reasonable approximations suitable for general engineering use. Due to commercial variations in compositions and to manufacturing limitations, they should not be used for specification purposes. See applicable ASTM International specification references.

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Copper.org: Resources: Standards & Properties - Properties of Wrought and Cast Copper Alloys Search

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### **Search Results**

C69430

Last Updated: Jul 06, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           | Cu <sup>(1)</sup> | As   | Fe  | Pb  |                 | Zn    |
|-----------|-------------------|------|-----|-----|-----------------|-------|
| Min./Max. | 80.0-83.0         | 0306 | .20 | .30 | 3.5-4. <u>5</u> | Rem.  |
| Nominal   | 81.5              | .04  | ļ   |     | 4.0             | 14.5_ |

(1) Cu value includes Ag.

Note: Cu + Sum of Named Elements, 99.5% min.

Applicable Specifications

| Product | Specification |
|---------|---------------|
| Rod     | ASTM B371     |

Common Fabrication Processes

Forging, Screw Machining

**Fabrication Properties** 

| I aprication 1 15 person       |             |
|--------------------------------|-------------|
|                                | Suitability |
| Soldering                      | Excellent_  |
|                                | Excellent_  |
|                                | Good        |
|                                | Good        |
|                                | Good        |
| Butt Weld                      | Good        |
| Capacity for Being Cold Worked | Good        |
| Capacity for Being Hot Formed  | 80          |
| Forgeability Rating            | 80          |
| Machinability Rating           | 30          |

| us shanical Deposition (measured at room temperature. | 68 | F ( | 20 | C) |  |
|---|----|-----|----|----|--|
|   |    |     |    |    |  |

|     | Section<br>Size |   | •   |    |     | Strength | Strength<br>(0,2% | Vield<br>Strength<br>(0.05%<br>offset) | Ēί | Rc<br>Ha | oci<br>erc | k•<br>In | rell<br>ess | Vickens<br>Hard. | Brit<br>Har | nell<br>d.   |              | Estigne  | tzod<br>Impact<br>Strengti |
|-----|-----------------|---|-----|----|-----|----------|-------------------|--|----|----------|------------|----------|-------------|------------------|-------------|--------------|--------------|----------|----------------------------|
|     | n.              | ₩ |     | F  | ksi | ksi      | ksi               | ksi                                    | *  | 8        | F          | F        | 301         | 500              | 500         | 3000         | ksi          | kai      | r:Ab                       |
|     | mai.            |   |     | c  | MPa | МРа      | MPa               | MPa                                    |    |          |            | Γ        |             |                  |             |              | мРа          | MPa      | J                          |
| Rod |                 | • |     |    |     |          |                   | _                                      | _  | Ţ        | _          | _        | _           |                  | _           | _            |              |          | 0.0                        |
| O60 | 2               | þ | TYP | 85 | 80  | 40       | <u> </u>          | <u> </u>                               | 2: | 8:       | Ł          | Ł        | <u> </u>    | <u> </u>         | ŧ~          | <del> </del> | <del> </del> |          | _                          |
|     | 50.6            |   |     | 20 | 552 | 276      | F                 | -                                      | þ  | ŧ:       | 1          | ŀ        | ŀ           | ł                | <u> </u>    | <u> </u>     | <u> </u>     |          | 0.0                        |
| OBO | 0.50            | 0 | TYP | 68 | 90  | 45       |                   |  | 20 | 18       | ł          | ŀ        | <u> </u>    | F                | Ł           | · _          | F            | <u> </u> | 0.0                        |
| _   | 12.7            | 1 | 1   | 20 |     | 310      | F                 | Į.                                     | 20 | ¥E:      | Ŧ          | F        | F           | F                | F           | ŀ            | ŀ            | <b>}</b> | 0.0                        |

Copper.org: Resources: Standards & Properties - Properties of Wrought and Cast Copper Alloys Search

|     |     | 1        |              | 1        |    | 1   | 1  | ı | 1             | 1         | 1 1         | ı | 1 | ١          | ı  |          |   | 1 | - 1 | <br> |
|-----|-----|----------|--------------|----------|----|-----|--|---|---------------|-----------|-------------|---|---|------------|----|----------|---|---|-----|------|
| Ļ   |     | <u> </u> | <del> </del> | <u> </u> |    | -   | <del>    -   -   -   -   -   -   -   -   -  </del> |   | <del></del>   | bs        | ē: 1        | + | ┢ | ┢          | _  |          |   | F |     | 0.0  |
| ľ   | D60 | 1        | <u>p</u>     | TYP      |    | 35  | 43   | — | 1             | 25        | Ę           | 1 | T | T          |    |          |   | F | -   | 0.0  |
| N   |     | 25.4     | 1_           |          | 20 | 585 | 298  | ┵ | +             | 21        | 딞           | + | ┨ | ╁╌         | -1 | _        | - | ┖ | t   | 0.0  |
| A   | H04 | 0.75     | <u> </u>     | ТҮР      | _  | 100 | - 5/<br>   | ╼ | <del>-[</del> | <u> </u>  | H           | t | t | t          |    |          |   | Γ | Ŧ   | 0.0  |
| ' 1 |     | 19.1     | 1            | ı        | 20 | 689 | 393  | t |               | <u>۴'</u> | <b>L.</b> 1 | Ĺ |   | <u>1</u> _ | پر | <u> </u> |   |   |     |      |

\*Fatigue Strength: 100 x 10 <sup>6</sup>cycles, unless indicated as [N]X 106.

Physical Properties

| Physical Properties              | US Customary                               | Metric                                   |
|----------------------------------|--|--|
| Melting Point - Liquidus         | 1685 F                                     | 918 C                                    |
| Melting Point - Solidus          | 1510 F                                     | 819 C                                    |
| Density                          | 0.26 lb/in <sup>3</sup> at 68 F            | 8.19 gm/cm <sup>3</sup> @ 20 C           |
| Specific Gravity                 | 8.19                                       | 8.19                                     |
| Electrical Resistivity           | 167.0 ohms-cmil/ft @ 68 F                  | 27.76 microhm-cm @ 20 C                  |
| Electrical Conductivity          | 6 %IACS @ 68 F                             | 0.036 MegaSiemens/cm @ 20 C              |
| Thermal Conductivity             | 15.0 Blu · ft/(hr · ft2.ºF)at 68           | F26.0 W/m · ºK at 20 C                   |
| Coefficient of Thermal Expansion | n 11.2 ·10 <sup>-6</sup> per °F (68-572 F) | 20.2 ·10 <sup>-6</sup> per °C (20-300 C) |
| Specific Heat Capacity           | 0.09 Btu/lb/ºF at 68 F                     | 377.1 J/kg · <sup>o</sup> K at 293 K     |
| Modulas of Elasticity in Tension |  | 110000 MPa                               |

Tempers Most Commonly Used No information available.

Typical Uses Industrial Valve Stems

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### Copper.ms

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### Search Results

C69700

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|          | Cu <sup>(1)</sup> | Fe | Рb      | Mn  | Sí      | Zn   |
|----------|-------------------|----|---------|-----|---------|------|
| Min/Max. | 75.0-80.0         | 20 | .50-1.5 | .40 | 2.5-3.5 | Rem. |
| Nominal  | 77.5              | -  | 1.0     | 1   | 3.0     | 18.5 |

(1) Cu value includes Ag.

Note: Cu + Sum of Named Elements, 99.5% min.

#### **Applicable Specifications**

| Product | Specification |
|---------|---------------|
| Rod     | ASTM B371     |

Common Fabrication Processes

Machining

**Fabrication Properties** 

|         | Technique     |    |
|---------|---------------|----|
| Machina | bility Rating | 70 |

Mechanical Properties (measured at room temperature, 68 F (20 C) No information available.

Physical Properties No information available.

Tempers Most Commonly Used No information available.

Typical Uses Industrial Valve Stems

Start Another Search

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### Copperam

**DOTATION OF THE TAXABLE TO THE TAX** 

### Search Results

C70600 (Copper-Nickel, 10%)

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           | Cu <sup>(1)</sup> | Fe      | ₽b  | Mn  | Ni <sup>(2)</sup> | Ζn  |
|-----------|-------------------|---------|-----|-----|-------------------|-----|
| Min./Max. | Rem.              | 1.0-1.8 | .05 | 1.0 | 9.0-11.0          | 1.0 |
| Nominal   | 88.6              | 1.4     | -   | 1.  | 10.0              | F   |

(1) Cu value includes Ag.

(2) Ni value includes Co.

Note: Cu + Sum of Named Elements, 99.5% min.

Applicable Specifications

| Product               | Specification   |
|-----------------------|---|
| Bar                   | ASTM B151, B122<br>MILITARY MIL-C-15726               |
| Pipe, Seamless        | ASME SB466<br>ASTM B466                               |
| Pipe, Welded          | ASME \$B467<br>ASTM B608, B467                        |
| Plate                 | ASTM B122<br>MILITARY MIL-C-15726                     |
| Plate, Clad           | ASTM B432   |
| Plate, Condenser Tube | ASME SB171<br>ASTM B171<br>SAE J463, J461             |
| Rod                   | ASTM B151<br>MILITARY MIL-C-15726                     |
| Rod, Welding          | AWS A5.15   |
| Sheet                 | ASTM B122<br>MILITARY MIL-C-15726<br>SAE J463, J461   |
| Strip                 | ASTM B122<br>MILITARY MIL-C-15726                     |
| Tube, Condenser       | ASME SB111<br>ASTM B552, B111<br>MILITARY MIL-T-15005 |

Copper.org: Resources: Standards & Properties - Properties of Wrought and Cast Copper Alloys ... Page 2 of 3

|                | SAE J463, J461  |
|----------------|---|
| Tube, Finned   | ASME SB359<br>ASTM B359<br>MILITARY MIL-T-22214       |
| Tube, Seamless | ASME SB466<br>ASTM B466, B469<br>MILITARY MIL-T-16420 |
| Tube, U-Bend   | ASME SB395<br>ASTM B395                               |
| Tube, Welded   | ASME SB543<br>ASTM B543<br>MILITARY MIL-T-16420       |
| Wire           | MILITARY MIL-C-15726                                  |

### **Common Fabrication Processes**

Forming and Bending, Welding

**Fabrication Properties** 

|                                | Suitability |
|--------------------------------|-------------|
| Soldering                      | Excellent   |
| Brazing                        | Excellent   |
| Oxyacetylene Welding           | Fair        |
| Gas Shielded Arc Welding       | Excellent   |
| Coated Metal Arc Welding       | Good        |
|                                | Good        |
| Seam Weld                      | Good        |
| Butt Weld                      | Excellent   |
| Capacity for Being Cold Worked | Good        |
| Capacity for Being Hot Formed  | Good        |
| Machinability Rating           | 20          |

Mechanical Properties (measured at room temperature, 68 F (20 C)

|        |                 |              |             |      |                     | 3 W 1 D D U I |                   |  |    |         |            | ·, ·       |     | 1-0              |      |            |                   |                      |                            |
|--------|-----------------|--------------|-------------|------|---------------------|---------------|-------------------|--|----|---------|------------|------------|-----|------------------|------|------------|-------------------|----------------------|----------------------------|
| Temper | Section<br>Size | Cold<br>Work | Typ/<br>Min | Temp | Tensile<br>Strength | Strength      | Strength<br>(0.2% | Yleld<br>Strength<br>(0.05%<br>offaet) | ΕI | π.<br>X | ogk<br>ard | nes<br>wel |     | Vickens<br>Hard. | Bri: | nell<br>d. | Shear<br>Strength | Fatigue<br>Strength* | izod<br>Impact<br>Strengti |
|        | ln.             | 70           |             | F    | ksi                 | ksi           | ksi               | ksi                                    | *  | β       | C          | F          | 301 | 500              | 500  | 3000       | ksi               | ksi                  | it-lib                     |
|        | mm.             | Γ            |             | C    | мРа                 | MPa           | MPa               | MPa                                    | Γ  | ľ       | П          |            |     |                  | Γ    |            | MPa               | MPa                  | h                          |
| Tube   | •               |              |             |      |                     |               |                   | •                                      |    |         |            |            |     | -                |      |            |                   |                      |                            |
| OS025  | O C             | 0            | TYP         | 88   | 44                  | 16            |                   |  | 42 | 15      | E          | 55         | 26  |                  | ŀ    | F .        |                   |                      | 0.0                        |
|        | 0,0             |              |             | 20   | 303                 | 110           | •                 | •                                      | 42 | 15      | F          | 35         | 28  | -                | F    | F          | -                 | -                    | 0.0                        |
| H55    | 0.0             | þ            | TYP         | 68   | 60                  | 57            |                   |  | 10 | 72      | Г          | 100        | 70  | F                | F    | F          |                   | -                    | 0.0                        |
| •      | 0.0             |              |             | 20   | 414                 | 393           |                   | -                                      | 10 | 72      | F          | 100        | 70  | ŀ                | F    | F          | -                 |                      | 6.0                        |

<sup>\*</sup>Fatigue Strength:  $100 \times 10^{6}$  cycles, unless indicated as [N]X  $10^{6}$ .

**Physical Properties** 

|                          | US Customary                     | Metric                         |
|--------------------------|----------------------------------|--------------------------------|
| Melting Point - Liquidus | 2100 F                           | 1149 C                         |
| Melting Point - Solidus  | 2010 F                           | 1099 C                         |
| Density                  | 0.323 lb/in <sup>3</sup> at 68 F | 8.94 gm/cm <sup>3</sup> @ 20 C |
| Specific Gravity         | 8.94                             | 8.94                           |
|                          |                                  |                                |

### Copper.org: Resources: Standards & Properties - Properties of Wrought and Cast Copper Alloys ... Page 3 of 3

| Electrical Resistivity           | 115,0 ohms-cmil/ft @ 68 F               | 19.12 microhm-cm @ 20 C                  |
|----------------------------------|---|--|
| Electrical Conductivity          | 9 %IACS @ 68 F                          | 0.053 MegaSiemens/cm @ 20 C              |
| Thermal Conductivity             | 26.0 Btu · ft/(hr · ft2·°F)at 68F       | 45.0 W/m ⋅ ºK at 20 C                    |
| Coefficient of Thermal Expansion | 9.5 ·10 <sup>-6</sup> per °F (68-572 F) | 17.1 ·10 <sup>-6</sup> per °C (20-300 C) |
| Specific Heat Capacity           | 0.09 Btu/lb/°F at 68 F                  | 377.1 J/kg · ºK at 293 K                 |
| Modulas of Elasticity in Tension | 18000 ksi                               | 124000 MPa                               |
| Modulus of Rigidity              | 6800 ksi                                | 46880 MPa                                |

**Tempers Most Commonly Used** 

| TOTAL POLOTINO | or opnimonity good            |
|----------------|-------------------------------|
| Flat Product   | S                             |
| PLATE          | M20                           |
| SHEET          | H01, H02, H04, O60            |
| STRIP, ROLI    | LED H01, H02, H04, O60, OS025 |

| Other |                   |
|-------|-------------------|
| PIPE  | H55, H80, O60     |
| TUBE  | H55, OS015, OS025 |

### **Typical Uses**

**Automotive** 

Power Steering Tube, Brake Lines

Consumer

Screw Lamp Bases

Industrial

Condenser Plates, Condensers, Weld Torch Tips, Heat Exchanger Tubes, Valve Bodies, Evaporator Tubes, Pressure Vessels, Distiller Tubes, Pump Impellers for Oil Refining, Ferrules, Evaporators

Marine

Boat Hulls, Tube Sheet for Salt Water Service, Salt Water Pipe Fittings, Salt Water Piping Systems, Salt Water Piling Wrap, Hot Water Tanks, Salt Water Baffles, Propeller Sleeves, Ship Hulls, Water Hoses

Flanges

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## Copper

到 美和的自动地位 時期 美国国际主任 雲 以为州 城市 机砂煤 配过差

### **Search Results**

C71500 (Copper-Nickel, 30%)

Last Updated: Apr 28, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           | Cu <sup>(1)</sup> | Fe      | Ρb  | Mn  | Ni <sup>(2)</sup> | Ζn  |
|-----------|-------------------|---------|-----|-----|-------------------|-----|
| Min./Max. | Rem.              | .40-1.0 | .05 | 1.0 | 29.0-33.0         | 1.0 |
| Nominal   | 69.5              | .50     | -   | -   | 30.0              | -   |

(1) Cu value includes Ag.

(2) Ni value includes Co.

Note: Cu + Sum of Named Elements, 99.5% min.

**Applicable Specifications** 

| Product               | Specification   |
|-----------------------|---|
| Bar                   | ASTM B122, B151<br>MILITARY MIL-C-15726<br>SAE J461, J463 |
| Bolts                 | ASTM F468   |
| Electrode, Welding    | AWS A5.6<br>MILITARY MIL-E-22200/4                        |
| Nuts                  | ASTM F467   |
| Pipe, Seamless        | ASME SB466<br>ASTM B466                                   |
| Pipe, Welded          | ASTM B608, B467   |
| Plate                 | ASTM B122<br>MILITARY MIL-C-15726<br>SAE J461, J463       |
| Plate, Clad           | ASTM B432   |
| Plate, Condenser Tube | ASME SB171<br>ASTM B171<br>SAE J463, J461                 |
| Rod                   | ASTM B151<br>MILITARY MIL-C-15726                         |
| Screws                | ASTM F468   |
| Sheet                 | ASTM B122<br>MILITARY MIL-C-15726<br>SAE J463, J461       |

Copper.org: Resources: Standards & Properties - Properties of Wrought and Cast Copper Alloys ... Page 2 of 4

| Strip           | ASTM B122<br>MILITARY MIL-C-15726<br>SAE J461, J463                     |
|-----------------|---|
| Studs           | ASTM F468   |
| Tube, Condenser | ASME SB111<br>ASTM B552, B111<br>MILITARY MIL-T-15005<br>SAE J463, J461 |
| Tube, Finned    | ASME SB359<br>ASTM B359<br>MILITARY MIL-T-22214                         |
| Tube, Seamless  | ASME SB466<br>ASTM B466<br>MILITARY MIL-T-16420                         |
| Tube, U-Bend    | ASME SB395<br>ASTM B395   |
| Tube, Welded    | ASME SB543<br>ASTM B543   |
| Wire            | MILITARY MIL-C-15726  |

### **Common Fabrication Processes**

Forming and Bending, Welding

**Fabrication Properties** 

| Joining Technique              | Suitability |
|--------------------------------|-------------|
| Soldering                      | Excellent   |
| Brazing                        | Excellent   |
| Oxyacetylene Welding           | Good        |
| Gas Shielded Arc Welding       | Excellent   |
| Coated Metal Arc Welding       | Excellent   |
| Spot Weld                      | Excellent   |
| Seam Weld                      | Excellent   |
| Butt Weld                      | Excellent   |
| Capacity for Being Cold Worked | Good        |
| Capacity for Being Hot Formed  | Good        |
| Machinability Rating           | 20          |

Mechanical Properties (measured at room temperature, 68 F (20 C)

Copper.org: Resources: Standards & Properties - Properties of Wrought and Cast Copper Alloys ... Page 3 of 4

| Témper      | Section<br>Size | Cold<br>Work | Typ/<br>Win | Temp | Tensila<br>Strength | 3 <del>be</del> nyth | 8បទngth<br>(0.2% | Yield<br>Strength<br>(0.05%<br>offset) | E   | Ro<br>Ha |    |     |   | Vickens<br>Hard.                             | Srli<br>Har                                  | nell<br>d.   | Shear<br>Strength                             | Strength'    | -    |       |
|-------------|-----------------|--------------|-------------|------|---------------------|----------------------|------------------|--|-----|----------|----|-----|---|--|--|--------------|---|--------------|------|-------|
|             | in.             | ×.           | ¥.          |      | F                   | _                    | ksi              | ksi                                    | ksi | γ,       | В  | þ   | ŀ | 307  | 500  | 500          | 3000  | ksi          | ksi  | ti-ti |
| <del></del> | mm.             |              | ┢           | c    | MPa                 | MPa                  | MPa              | MPa                                    |     |          |    | 1   |   |  |  |              | МРа   | MPa          | j    |       |
| Rod         |                 |              |             |      |                     |                      |                  |  | _   | _        | _  | _   | _ |  | _  |              | _   |              | h o  |       |
| H02         | 1               | 20           | TYP         | 68   | 75                  | 70                   |                  |  | 15  | 80       | 밚  | 4   | • | <u> </u>                                     | <u> </u>                                     | <del> </del> | <u> </u>                                      | <del></del>  | 0.0  |       |
|             | 25.4            |              |             | 20   | 517                 | 483                  | <b>r</b>         |  | 15  | 8C       | ŀŀ | . } | • | <u>                                     </u> | <u>t                                    </u> | <u>t</u>     | <u>t                                     </u> | <u>t</u>     | 0.0  |       |
| Tube        |                 |              |             |      |                     |                      |                  |  | _   | _        |    | _   |   |  | _  | τ —          | _   |              | 0.0  |       |
| ()\$035     | 0,0             | ٥_           | TYP         | 88   | 54                  | ·                    | <u> </u>         | <u> </u>                               | 4:  | 36       | Ц  |     |   | <u> </u>                                     | Ļ.   | -            | _   | _            | _    |       |
|             | 0.0             |              | Γ           | 20   | 372                 | F                    | <u> </u>         | ŀ                                      | 45  | 36       | L  | 7   | • |  | <u> </u>                                     | <u> </u>     | <u> </u>                                      | <u> </u>     | 0.0  |       |
| OS025       | 0.0             | Ь            | TYP         | 68   | 60                  | 25                   | F                | F                                      | 4   | 45       | Ð  | 90  |   | <u> </u>                                     | Ł.   | Ŀ            | <u> </u>                                      | <u> </u>     | 0.0  |       |
|             | 0.0             |              | Π           | 20   | 414                 | 172                  | F                | F                                      | 4   | 45       | Ł  | 80  | _ |  | Ŀ  | <u> </u>     | <u> </u>                                      | <u> </u>     | 0.0  |       |
| Flat Pri    | oducts          |              |             |      |                     |                      |                  |  |     |          |    |     |   |  | _  |              |   |              | lo o |       |
| M20         | 1               | b            | TYP         | 38   | 55                  | 20                   | - <u>_</u>       | <u> </u>                               | 1:  | 35       | Ц  | _   | _ | <u> </u>                                     | Ł  | 上            | <u> </u>                                      | <del> </del> | 0.0  |       |
|             | 25.4            | Π            | Т           | 20   | <b>3</b> 79         | 138                  | F                | ŀ                                      | ŀ   | 3:       | Ł  | - ' | ٠ | <u> </u>                                     | <u>Ł</u> _                                   | <u> </u>     | <u> </u>                                      | <u> </u>     | 0.0  |       |

\*Fatigue Strength: 100 x 10 <sup>6</sup>cycles, unless indicated as [N]X 106.

Dhysical Properties

| Physical Properties              |                                   |  |  |  |  |  |  |  |
|----------------------------------|-----------------------------------|--|--|--|--|--|--|--|
|                                  | US Customary                      | Metric                                   |  |  |  |  |  |  |
| Melting Point - Liquidus         | 2260 F                            | 1238 C                                   |  |  |  |  |  |  |
| Melting Point - Solidus          | 2140 F                            | 1171 C                                   |  |  |  |  |  |  |
| Density                          | 0.323 lb/in <sup>3</sup> at 68 F  | 8.94 gm/cm <sup>3</sup> @ 20 C           |  |  |  |  |  |  |
| Specific Gravity                 | 8.94                              | 8.94                                     |  |  |  |  |  |  |
| Electrical Resistivity           |                                   | 37.4 microhm-cm @ 20 C                   |  |  |  |  |  |  |
| Electrical Conductivity          | 4 %IACS @ 68 F                    | 0.027 MegaSiemens/cm @ 20 C              |  |  |  |  |  |  |
| Thermal Conductivity             | 17.0 Btu · ft/(hr · ft2·°F)at 68F | 29.4 W/m · °K at 20 C                    |  |  |  |  |  |  |
| Coefficient of Thermal Expansion |                                   | 16.2 ·10 <sup>-6</sup> per °C (20-300 C) |  |  |  |  |  |  |
| Specific Heat Capacity           | 0.09 Btu/lb/ºF at 68 F            | 377.1 J/kg · °K at 293 K                 |  |  |  |  |  |  |
| Modulas of Elasticity in Tension |                                   | 152000 MPa                               |  |  |  |  |  |  |
| Modulus of Rigidity              | 8300 ksi                          | 57230 MPa                                |  |  |  |  |  |  |

Tempers Most Commonly Used

| Flat Products |                           |
|---------------|---------------------------|
| PLATE         | M20                       |
| SHEET         | H01, H02, O60             |
| STRIP, ROLLED | H01, H02, H04, O60, OS025 |

| Other       |                 |  |  |  |  |  |  |
|-------------|-----------------|--|--|--|--|--|--|
| PIPE H55, I | 180, O60        |  |  |  |  |  |  |
| ROD H02     |                 |  |  |  |  |  |  |
| TUBE OS01   | 5, OS025, OS035 |  |  |  |  |  |  |

### **Typical Uses**

Pump Impellers, Heat Exchanger Tubes, Evaporator Tubes, Distiller Tubes, Condenser Plates, Refrigerators, Process Equipment, Condenser Components, Ferrules, Welding Backing Rings, Flexible Metal Hose, Weld Wire, Boiler Parts, Condensers, Propeller Sleeves, Heat Exchanger Components

Salt Water Flanges, Salt Water Piping, Valve Bodies, Sea Water Service, Fittings, Sea Water Condensers, Salt Water Pipe Fittings, Water Boxes - Salt Water Applications, Pump Bodies and Internal Parts-Sea Water

http://www.copper.org/resources/properties/db/CDAPropertiesResultServlet.jsp?action=search

Copper.org: Resources: Standards & Properties - Properties of Wrought and Cast Copper Alloys ... Page 4 of 4

### Start Another Search

DISCLAIMER:

The values listed above represent reasonable approximations suitable for general engineering use. Due to commercial variations in compositions and to manufacturing limitations, they should not be used for specification purposes. See applicable ASTM International specification references.

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Copper.org: Resources: Standards & Properties - Properties of Wrought and Cast Copper Alloys Search

Page 1 of 1

Copper Development Association



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### Search Results

C76000

Last Updated: Jul 06, 2008

**Chemical Composition** 

(%max., unless shown as range or min.)

|           | Cu <sup>(1)</sup> | Fe  | Pb | Mn | Ni <sup>(2)</sup> | Zn   |
|-----------|-------------------|-----|----|----|-------------------|------|
| Min./Max. | 60.0-63.0         | .25 | 10 | 50 | 7.0 <b>-9</b> .0  | Rem. |
| Nominal   | 61.5              | ,   |    |    | 8.0               |      |

(1) Cu value includes Ag.

(2) Ni value includes Co.

Note: Cu + Sum of Named Elements, 99.5% min.

Applicable Specifications No information available.

### **Common Fabrication Processes**

No information available.

Fabrication Properties No information available.

Mechanical Properties (measured at room temperature, 68 F (20 C) No information available.

Physical Properties No information available.

Tempers Most Commonly Used No information available.

Typical Uses Builders Hardware Hardware

Start Another Search

### DISCLAIMER:

The values listed above represent reasonable approximations suitable for general engineering use. Due to commercial variations in compositions and to manufacturing limitations, they should not be used for specification purposes. See applicable ASTM International specification references.

# EXHIBIT 9

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FINANCIAL

JAN-29-1996 ØB: Ø1 FROM OLIN ACCOUNTING INDPLS

### **BRASS - INDIANAPOLIS**

INVOICE NO.: 10768 CUSTOMER NO.: \$1545 BOL NO.: 528

BOL NO. : 528 CONTRACT NO.: 4929.011

INVOICE DATE : (01/16/96

SHIPPED DATE : 01/16/96

PACKING LIST: 2959

96A0525

SOLD TO:

CHEMBICO

3200 S. ST. LOUIS ST. CHICAGO, IL 60613

SHIP TO:

**ALLOY** DESCRIPTION

GROSS

NET

PRICE AMOUNT

8726

AJAX PIT CLEANIN

39,944 32,862 0.4500\$ 14,787.90

CREDITS/OTHER CHARGES:

PROVISIONAL BILLING

\$ 0.00

TOTAL DUE:

\$ 14,787.90

TERMS: NET 30 DAYS

FROM DATE OF SHIPMENT

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359

CHICAGO, IL 60675-2359

COMMENTS:

FEB-01-1996 12:56 FROM OLIN ACCOUNTING INDPLS

### **BRASS - INDIANAPOLIS**

printed 06/01/2011 11:04AM by Luttie.Boarman p. 214/361

INVOICE NO.: 10798 CUSTOMER NO.: \$1545 BOL NO.: 542

CONTRACT NO.: 5566.011

INVOICE DATE : 01/26/96 SHIPPED DATE : 01/26/96

PACKING LIST: 2981

96A 0548

SOLD TO: CHEMETCO

3200 S. ST. LOUIS ST. CHICAGO, ILL 60613

SHIP TO:

TO .

ALLOY DESCRIPTION

6000 FRNCE SCRNG

NET 33,580

GROSS

0.4200\$ 14,103.60

PRICE

CREDITS/OTHER CHARGES:

PROVISIONAL BILLING

\$ 0.00

TOTAL DUE:

\$ 14,103.60

TERMS: NET 30 DAYS

FROM DATE OF SHIPMENT

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS P.O. BOX 92359

CHICAGO, IL 60675-2359

COMMENTS:

8722

## OLIN BRASS - INDIANAPOLIS

INDIANAPOLIS, INDIANA

printed 06/01/2011 11:04AM by Luttie.Boarman p. 215/361

INVOICE NO.: 10821 CUSTOMER NO.: \$1545 BOL NO. : 555 CONTRACT NO.: 5477.011 INVOICE DATE : 02/13/96 SHIPPED DATE : 02/13/96 PACKING LIST : 3003

•

96B0535

SOLD TO:

CHEMETCO

3200 8. ST. LOUIS ST. CHICAGO, IL 60613

SHIP TO:

ΤÖ

ALLOY

DESCRIPTION

GROSS

NET PRICE

AMOUNT

**B722** 

6000 FRNCE SCRNG

43,766

34,698

0.4200\$ 14,573.16

CREDITS/OTHER CHARGES:

\$ 0.00

TOTAL DUE:

\$ 14,573.16

TERMS: NET 30 DAYS

FROM DATE OF SHIPMENT

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359

CHICAGO, IL 60675-2359

COMMENTS:

APPROVED BY:\_ U

TOTAL P.07

#### <u> ASS - INDIANAPOLIS</u>

INDIANAPOLIS, INDIANA

INVOICE NO.: 10827 CUSTOMER NO.: \$1545

: 564 BOL NO.

CONTRACT NO.: 5477.011

INVOICE DATE : 02/19/96) SHIPPED DATE: 02/19/96

PACKING LIST: 3013

9662527

SOLD TO: CHEMETCO

3200 S. ST. LOUIS ST.

CHICAGO, IL 60613

SHIP TO:

NET PRICE THUOMA ALLOY DESCRIPTION GROSS 0.5000\$ 15,759.00 8726 PIT CLEANINGS 41,086 31,518

CREDITS/OTHER CHARGES:

PROVISIONAL BILLING

\$ 0.00

TOTAL DUE:

\$ 15,759.00

TERMS: NET 30 DAYS

FROM DATE OF SHIPMENT

PLEASE REMIT TO: OLIN BRASS - INDIANAPOLIS P.O. BOX 92359 CHICAGO, IL 60675-2359

FINANCIAL

# **BRASS - INDIANAPOLIS**

INDIANAPOUS, INDIANA

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INVOICE NO. : 10838 CUSTOMER NO. : 51545 BOL NO. : 567

CONTRACT NO.: 5477.011

INVOICE DATE : SHIPPED DATE : PACKING LIST :

02/21/96

3020

9660528

SOLD TO:

CHEMETCO

3200 E. ST. LOUIS ST.

CHICAGO, IL 60613

SHIP TO:

ALLOY DESCRIPTION GROSS PRICE NET

8726

PIT CLEANINGS

42,225

33,360

0.5000\$ 16,680.00

CREDITS/OTHER CHARGES:

PROVISIONAL BILLING

\$ 0.00

MOUNT

TOTAL DUE:

\$ 16,680.00

TERMS: NET 30 DAYS

FROM DATE OF SHIPMENT

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359 CHICAGO, IL 60675-2359

FINANCIAL

P.15

#### **BRASS - INDIANAPOLIS**

INDIANAPOLIS, INDIANA

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INVOICE NO. : 10839 CUSTOMER NO. S1545 BOL NO. 566

CONTRACT NO.: 5477.011

INVOICE DATE : 02/20/98 SHIPPED DATE : 02/20/96

PACKING LIST : 3014

96600505

SOLD TO: CHEMETCO

3200 S. ST. LOUIS ST. CHICAGO, IL 60613

SHIP TO:

PRICE AMOUNT DESCRIPTION GROSS . NET ALLOY 0.5000\$ 16,178.00 8726 32,356 PIT CLEANINGS 40,324

CREDITS/OTHER CHARGES:

PROVISIONAL BILLING

\$ 0.00

TOTAL DUE:

\$ 16,178.00

TERMS: NET 30 DAYS

FROM DATE OF SHIPMENT

PLEASE REMIT TO: OLIN BRASS - INDIANAPOLIS P.O. BOX 92359 CHICAGO, IL 60675-2359

COMMENTS:

APPROVED BY:\_ W.L.

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FINANCIAL

MAR-04-1996 14:11 FROM OLIN ACCOUNTING INDPLS TO

# <u> ASS - INDIANAPOLIS</u>

INVOICE NO. : (10844 CUSTOMER NO.: \$1545 BOL NO. : 570

CONTRACT NO .: VERBAL

INVOICE DATE : 02/22/96 SHIPPED DATE : 02/22/96 PACKING LIST : 3021

SOLD TO: CHEMETCO

3200 S. ST. LOUIS ST. CHICAGO, IL 60613

SHIP TO:

ALLOY

DESCRIPTION

GROSS\_

net

PRICE

8726

SCRAP

31,918

0.4500\$ 14,363.10

CREDITS/OTHER CHARGES:

PROVISIONAL BILLING

\$ 0.00

TOTAL DUE:

\$ 14,363.10

TERMS: NET 30 DAYS

FROM DATE OF SHIPMENT

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359 CHICAGO, IL 60675-2359

FINANCIAL

#### **BRASS - INDIANAPOLIS**

INDIANAPOLIS, INDIANA

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INVOICE NO. : 10845 CUSTOMER NO.: 81545 BOL NO. : N/A CONTRACT NO.: VERBAL

INVOICE DATE : 02/23/96
SHIPPED DATE : 02/23/96
PACKING LIST : 3023

96/20542

CHEMETCO SOLD TO:

3200 S. ST. LOUIS ST. CHICAGO, IL 60613

SHIP TO:

ALLOY

DESCRIPTION

GROSS NET

PRICE AMOUNT

8726

SCRAP

33,018

0.4500\$ 14,858.10

CREDITS/OTHER CHARGES:

PROVISIONAL BILLING

\$ 0.00

TOTAL DUE:

\$ 14,858.10

TERMS: NET 30 DAYS

FROM DATE OF SHIPMENT

PLEASE REMIT TO: OLIN BRASS - INDIANAPOLIS P.O. BOX 92359 CHICAGO, IL 60675-2359

# **BRASS - INDIANAPOLIS**

printed 06/01/2011 11:04AM by Lutti-

INVOICE NO. : 10846-CUSTOMER NO. : -81545 : 574 BOL NO. CONTRACT NO.: VERBAL INVOICE DATE : 02/27/96 SHIPPED DATE : 02/27/96 SHIPPED DATE: 02/27 PACKING LIST: 3025

SOLD TO: CHEMETCO

3200 S. ST. LOUIS ST. CHICAGO, IL 60613

SHIP TO:

ALLOY DESCRIPTION GROSS PRICE AMOUNT NET

8726

SCRAP

27,608

0.4500\$ 12,423.60

9660543

CREDITE/OTHER CHARGES:

PROVISIONAL BILLING

\$ 0.00

TOTAL DUE:

\$ 12,423.60

TERMS: NET 30 DAYS

FROM DATE OF SHIPMENT

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359 CHICAGO, IL 60675-2359

**COMMENTS:** 

TOTAL P.07

# <u> BRASS - INDIANAPOLIS</u>

printed 06/01/2011 11:04AM by Luttie.Boarman p. 222/361 .

INVOICE NO.: 10860 CUSTOMER NO.: \$1545 BOL NO. 580 CONTRACT NO.: VERBAL

INVOICE DATE : 03/05/96 SHIPPED DATE : 03/05/96 PACKING LIST : 3032

96 C05/3

SOLD TO: CHEMETCO

3200 S. ST. LOUIS ST.

CHICAGO, IL 60623

DESCRIPTION **YOTTY** 

GROSS

NET

SHIP TO:

PRICE

8722

6000 SERIES

34,092

. .

0.4500\$ 15,341.40

CREDITS/OTHER CHARGES:

PROVISIONAL BILLING

\$ 0.00

TOTAL DUE:

\$ 15,341.40

TERMS: NET 30 DAYS

FROM DATE OF SHIPMENT

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS P.O. BOX 92359 CHICAGO, IL 60675-2359

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P.04 FINANCIAL

APR-02-1996 11:01 FROM OLIN ACCOUNTING INDPLS

#### **BRASS - INDIANAPOLIS**

INVOICE NO. : 10876 CUSTOMER NO.: \$1545

BOL NO. : 613 CONTRACT NO.: 7917.010 INVOICE DATE : 03/26/96 SHIPPED DATE : 03/26/96 PACKING LIST : 3075

96 C0532

SOLD TO: CHEMETCO

3200 S. ST. LOUIS ST. CHICAGO, IL 60623

SHIP TO:

TO

**YTTOX** DESCRIPTION GROSS NET PRICE TKUOMA 8722 0.3700\$ 12,858.24 6000 FRNCE SCRNG 43,172 34,752

CREDITS/OTHER CHARGES:

PROVISIONAL BILLING

\$ 0.00

TOTAL DUE:

\$ 12,858.24

TERMS: NET 30 DAYS

FROM DATE OF SHIPMENT

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359

CHICAGO, IL 60675-2359

COMMENTS:

#### <u>IN BRASS - INDIANAPOLIS</u>

INVOICE NO. : 10889 CUSTOMER NO. : 51545 POT. NO. : 618

CONTRACT NO.: 7917.010

(03/29/95) INVOICE DATE : SHIPPED DATE : 03/29/96

PACKING LIST : 3083

SOLD TO: CHEMETCO

3200 S. ST. LOUIS ST.

CRICAGO, IL 60623

<u> Alloy</u> DESCRIPTION **GROSS** NET PRICE AMOUNT

8726

PIT CLEANINGS

33,002

SHIP TO:

0.3700\$ 12,210.74

CREDITS/OTHER CHARGES:

PROVISIONAL BILLING

\$ 0.00

TOTAL DUE:

\$ 12,210.74

TERMS: NET 30 DAYS

FROM DATE OF SHIPMENT

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359 CHICAGO, IL 60675-2359

#### **BRASS - INDIANAPOLIS**

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INVOICE NO. : 10917 S1545 CUSTOMER NO.:

BOL NO. 523 CONTRACT NO.: 7917.010 INVOICE DATE : 04/02/96 SHIPPED DATE : 04/02/96

3093 PACKING LIST :

96 20519

SOLD TO:

CHEMETCO

3200 S. ST. LOUIS ST.

CHICAGO, IL 60623

ALLOY DESCRIPTION GROSS

NET

PRICE THUOMA

8726

PIT CLEANINGS

34,932

SHIP TO:

0.3600\$ 12,575.52

CREDITE/OTHER CHARGES:

PROVISIONAL BILLING

\$ 0.00

TOTAL DUE:

\$ 12,575.52

TERMS: NET 30 DAYS

FROM DATE OF SHIPMENT

PLEASE REMIT TO: OLIN BRASS - INDIANAPOLIS P.O. BOX 92359

CHICAGO, IL 60675-2359

## IN BRASS - INDIANAPOLIS

INDIANAPOLIS, INDIANA

INVOICE NO. : 10918 CUSTOMER NO.: \$1545

BOL NO. CONTRACT NO.: 631

7917.010

INVOICE DATE : 04/09/96 SHIPPED DATE : 04/09/96 PACKING LIST : 3101

96210520

SOLD TO: CHEMETCO

3200 S. ST. LOUIS ST. CHICAGO, IL 60623

NET PRICE **GROSS** 

TRUOMA

8726

ALLOY

PIT CLEANING

DESCRIPTION

34,836

SHIP TO:

0.3700\$ 12,889.32

CREDITS/OTHER CHARGES:

PROVISIONAL BILLING

\$ 0.00

TOTAL DUE:

\$ 12,889.32

TERMS: NET 30 DAYS

FROM DATE OF SHIPMENT

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359 CHICAGO, IL 60675-2359

**COMMENTS:** 

# **BRASS - INDIANAPOLIS**

INDIANAPOLIS, INDIANA

INVOICE NO. : 10928 CUSTOMER NO.: S1545

BOL NO. : 640 CONTRACT NO.: 6230.021

INVOICE DATE : 04/19/96 SHIPPED DATE : 04/19/96 PACKING LIST : 3114

9620531

SOLD TO: CHEMETCO

3200 S. ST. LOUIS ST. CRICAGO, IL 60623

SHIP TO:

TO

PRICE AMOUNT YLLOX DESCRIPTION **GROSS** NET 3538 353 BILLET CUTS 12,674 0.5300 \$ 6,717.22

CREDITS/OTHER CHARGES:

\$ 0.00

TOTAL DUE:

\$ 6,717.22

TERMS: NET 30 DAYS

FROM DATE OF SHIPMENT

PLEASE REMIT TO: OLIN BRASS - INDIANAPOLIS P.O. BOX 92359 CHICAGO, IL 60675-2359

COMMENTS:

# **BRASS - INDIANAPOLIS**

INDIANAPOLIS, INDIANA

INVOICE NO. : 10929 CUSTOMER NO.: \$1545

BOL NO. 640 CONTRACT NO.: 6230.021 INVOICE DATE : 04/19/96 SHIPPED DATE : 04/19/96

PACKING LIST: 3114

9600532

SOLD TO: CHEMETCO

3200 S. ST. LOUIS ST. CHICAGO, IL 60623

SHIP TO:

| ALLOY | DESCRIPTION      | GROSS | NET   | PRICE  | AMOUNT   |
|-------|------------------|-------|-------|--------|----------|
| 3600  | 3608 BILLET CUTS | •     | 6,256 | 0.5300 | 3,315.68 |

CREDITS/OTHER CHARGES:

\$ 0.00

TOTAL DUE:

\$ 3,315.68

PLEASE REMIT TO: OLIN BRASS - INDIANAPOLIS P.O. BOX 92359 CHICAGO, IL 60675-2359

TERMS: NET 30 DAYS

FROM DATE OF SHIPMENT

COMMENTS:

## <u>IN BRASS - INDIANAPOLIS</u>

INDIANAPOLIS, INDIANA

INVOICE NO. : 10930 CUSTOMER NO.: 51545

BOL NO. : 64D CONTRACT NO.: 6230.010 INVOICE DATE : 04/19/96 SHIPPED DATE : 04/19/96 PACKING LIST : 3115

9600523

CHEMETCO SOLD TO:

3200 S. ST. LOUIS ST. CHICAGO, IL 60623

SHIP TO:

**GROSS** ALLOY DESCRIPTION

PRICE NET

AMOUNT

1458

145 BILLET CUTS

16,048

0.9500\$ 15,245.60

CREDITS/OTHER CHARGES:

\$ 0.00

TOTAL DUE:

\$ 15,245.60

TERMS: NET 30 DAYS

FROM DATE OF SHIPMENT

PLEASE RENIT TO: OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359 CHICAGO, IL 60675-2359

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INDIANAPOLIS, INDIANA

INVOICE NO.: 10931 CUSTOMER NO.: S1545

BOL NO. 646 CONTRACT NO.: 7917.010 INVOICE DATE : 04/22/96 SHIPPED DATE : 04/22/96 PACKING LIST : 3120

96 DO534

SOLD TO: CHEMETCO

3200 S. ST. LOUIS ST. CHICAGO, IL 60623

SHIP TO:

TO

ALLOY DESCRIPTION

GROSS\_

NET PRICE AMOUNT

8722

6000 SERIES

20,494

0.3500 \$ 7,172.90

CREDITS/OTHER CHARGES:

PROVISIONAL BILLING

\$ 0.00

TOTAL DUE:

\$ 7,172.90

TERMS: NET 30 DAYS

FROM DATE OF SHIPMENT

PLEASE REMIT TO: OLIN BRASS - INDIANAPOLIS P.O. BOX 92359

CHICAGO, IL 60675-2359

COMMENTS:



INVOICE #

960505 CUSTOMER# (\$1545)

BOL#

656

CONTRACT#

7917.010

SOLD TO:

Chemetco

3200 S. St. Louis St. Chicago, IL 60623

INVOICE DATE (

SHIPPED DATE

**PACKING LIST** 

03132

96E0503

| ALLOY | DESCRIPTION | NET LBS | PRICE     | AMOUNT     |
|-------|-------------|---------|-----------|------------|
| 8722  | 6000 SERIES | 21,482  | \$0.33000 | \$7,089.06 |

TOTAL DUE:

\$7,089.06

**TERMS NET 30 DAYS** 

COMMENTS:

PROVISIONAL BILLING

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



INVOICE # (

960524 CUSTOMER# (\$1545

BOL#

689

CONTRACT#

7917.010

INVOICE DATE 5/31/96

SHIPPED DATE PACKING LIST

3168

SOLD TO:

Chemetco

3200 S. St. Louis St. Chicago, IL 80623

| <br>ALLOY | DESCRIPTION | NET LBS | PRICE     | AMOUNT             |
|-----------|-------------|---------|-----------|--------------------|
| <br>8722  | 6000 SERIES | 14,758  | \$0.32000 | \$4,722.56         |
| 8722      | 2000 SERIES | 16,782  | \$0.36000 | <b>\$</b> 6,041.52 |

TOTAL DUE:

\$10,764.08

TERMS NET 30 DAYS

COMMENTS:

PROVISIONAL BILLING

PLEASE REMIT TO: **OLIN BRASS - INDIANAPOLIS** P.O. BOX 92359



INVOICE#

CUSTOMER# BOL#

CONTRACT#

7917.010

INVOICE DATE

SHIPPED DATE

**PACKING LIST** 

5/31/98

3169

SOLD TO:

Chemetco

3200 S. St. Louis St.

Chicago, IL 60623

96E0505

| ALLOY  | DESCRIPTION | NET LBS | PRICE     | AMOUNT     |
|--------|-------------|---------|-----------|------------|
| 8722 6 | 000 SERIES  | 22.232  | \$0,36000 | \$8,003.52 |

**TOTAL DUE:** 

\$8,003.52

**TERMS NET 30 DAYS** 

COMMENTS: PROVISIONAL BILLING

PLEASE REMIT TO: OLIN BRASS - INDIANAFOLIS P.O. BOX 92359 CHICAGO, IL 60675-2359



INVOICE #

CUSTOMER# \$1545 BOL#

CONTRACT# 7917,010

SOLD TO:

Chemetoo

3200 S. St. Louis St.

Chicago, IL 60623

SHIPPED DATE 6/28/96

PACKING LIST

3211

96F 0520

| <br>ALLOY | DESCRIPTION | NET LBS | PRICE     | AMOUNT     |
|-----------|-------------|---------|-----------|------------|
| 8722      | 7000 SERIES | 8,422   | \$0.30000 | \$2,526.60 |
| 8722      | 6000 SERIES | 23,318  | \$0.30000 | \$8,995.40 |

TOTAL DUE:

TERMS **NET 30 DAYS** 

COMMENTS:

PROVISIONAL BILLING

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359



**INVOICE** #

960707

CUSTOMER#

S1545

BOL#

SOLD TO:

732

**CONTRACT#** 

7917.010

Chemetoo

3200 S. St. Louis St.

Chicago, IL 60623

INVOICE DATE

7/10/96

SHIPPED DATE

7/10/96

**PACKING LIST** 

3221

96 G 0506

**ALLOY** 

DESCRIPTION

**NET LBS** 

PRICE

**AMOUNT** 

8722

3000 SERIES

31,238

\$0.22000

\$6,872.36

**TOTAL DUE:** 

\$6,872.36

**TERMS** 

**NET 30 DAYS** 

COMMENTS:

PROVISIONAL BILLING

**PLEASE REMIT TO:** 

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359

96N 0500



INVOICE # 960801

CUSTOMER # \$1545

BOL# 751

CONTRACT# 7917.010

SHIPPED DATE 8/19/96
PACKING LIST 3246

SOLID TO: CI

Chemetoo 3200 S. St. Louis St.

Chicago, IL 60623

ALLOY

DESCRIPTION

NET LBS

PRICE

**AMOUNT** 

8722

3000 SERIES

34,514

\$0.26000

\$8,973.64

TOTAL DUE:

\$8,973.64

TERMS N

**NET 30 DAYS** 

COMMENTS:

PROVISIONAL BILLING

APPROVED BY: 2597

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359

96\$ 0508

# LIN BRASS-INDIANAPOLIS

INDIANAPOLIS, INDIANA

INVOICE # CUSTOMER #

754

BOL# CONTRACT# 7917.010 INVOICE DATE

SHIPPED DATE

8/20/96 8/20/96

PACKING LIST 3247

SOLD TO:

Chemetco

3200 S. St. Louis St. Chicago, IL 60623

**ALLOY** 

DESCRIPTION

**NET LBS** 

PRICE

AMOUNT

8722

2000 SERIES

33,136

\$0.26000

\$8,615.36

TOTAL DUE:

\$8,615.36

TERMS NET 30 DAYS

COMMENTS:

PROVISIONAL BILLING

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



INVOICE # 980812 CUSTOMER#

BOL#

CONTRACTS 7917.010 INVOICE DATE( 8/30/96 SHIPPED DATE 8/30/96 PACKING LIST 3286

SOLD TO:

printed 06/01/2011 11:04AM by Luttie.Boar<del>man p.</del>

Chemetco

3200 S. St. Louis St. Chicago, IL 60623

96 A 0510

**AMOUNT ALLOY NET LBS** PRICE DESCRIPTION 31,588 \$0.30000 \$9,476.40 8722 6000 SERIES

TOTAL DUE:

\$9,476.40

TERMS **NET 30 DAYS** 

COMMENTS: PROVISIONAL BILLING

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359



# LIN BRASS - INDIANAPOLIS

#### INDIANAPOLIS, INDIANA

INVOICE # (CUSTOMER # (

30L# 77

INVOICE DATE (

PACKING LIST

8/30/96 8/30/96 3285

CONTRACT#

7917.010

SOLD TO:

Chemetoo

3200 S. St. Louis St. Chicago, IL 60623 96×10513

ALLOY

DESCRIPTION

NET LBS

PRICE

**AMOUNT** 

8722

6000 SERIES

33,936

\$0.30000

\$10,180.80

TOTAL DUE:

\$10,180.80

TERMS

**NET 30 DAYS** 

COMMENTS:

PROVISIONAL BILLING

ADDONUED DV:

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359



INDIANAPOLIS, INDIANA

INVOICE # 960908 CUSTOMER # \$1545

BOL#

796

CONTRACT#

7917.010

SOLD TO: Chemetco

3200 S. St. Louis St. Chicago, IL 60623 INVOICE DATE 9/11/96 SHIPPED DATE 9/11/96 PACKING LIST 3313

96 I 0509

| ALLOY | DESCRIPTION | 1 | NET LBS | PRICE     | THUOMA     |
|-------|-------------|---|---------|-----------|------------|
| 8722  | 2000 SERIES |   | 33,264  | \$0.26000 | \$8,648.64 |

**TOTAL DUE:** 

\$8,648.64

TERMS NET 30 DAYS

COMMENTS:

PROVISIONAL BILLING

APPROVED BY:

**PLEASE REMIT TO:** 

OLIN-BRASS - INDIANAPOLIS

P.O. BOX 92359



INVOICE #

CUSTOMER \*

786

**CONTRACT#** 

7917.010

SOLD TO:

Chemetco

3200 S. St. Louis St. Chicago, IL 60623

INVOICE DATE

SHIPPED DATE

PACKING LIST

3300

96 T.05/0

| ALLOY | DESCRIPTION |  |
|-------|-------------|--|
|       |             |  |

**NET LBS** 

PRICE

AMOUNT

8722 2000 SERIES 34,432

\$0.26000

\$8,952.32

TOTAL DUE:

\$8,952.32

TERMS

**NET 30 DAYS** 

COMMENTS:

PROVISIONAL BILLING

**PLEASE REMIT TO:** 

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



invoice# (

CUSTOMER # \$1545

BOL#

801

960916

CONTRACT# 7917.010

SEP-26-1996 12:24 FROM

INVOICE DATE

OLIN ACCOUNTING INDPLS

9/18/98

SHIPPED DATE

9/18/96

PACKING LIST 3320

967 US16

SOLD TO:

Chemetoo

3200 S. St. Louis St. Chicago, IL 60623

ALLOY

DESCRIPTION

NET LBS

PRICE

AMOUNT

8722

2000 SERIES

35,220

\$0.26000

\$9,157.20

TOTAL DUE:

\$9,157.20

TERMS NET 30 DAYS

COMMENTS:

**PROVISIONAL BILLING** 

APPROVED BY:

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359



INVOICE #

960917 \$1545

GUSTOMER #(

802

CONTRACT# 7917,010

INVOICE DATE

SHIPPED DATE

9/18/96

PACKING LIST

3321

SOLD TO:

Chemetoo

3200 S. St. Louis St.

Chicago, IL 60623

96I 0517

ALLOY

DESCRIPTION

**NET LBS** 

PRICE

**AMOUNT** 

8722

3000 SERIES

33,876

\$0,26000

\$8,807.76

TOTAL DUE:

\$8,807.76

TERMS

**NET 30 DAYS** 

COMMENTS:

PROVISIONAL BILLING

APPROVED BY-

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359



INVOICE # 9609

CUSTOMER # \$1545 BOL# 807

CONTRACT#

807 7917.010 INVOICE DATE

SHIPPED DATE

9/19/96 9/19/96

PACKING LIST 3323

96\_I0518

SOLD TO:

Chemetoo

3200 S, St. Louis St. Chicago, IL 60623

ALLOY

DESCRIPTION

NET LES

PRICE .

**AMOUNT** 

8722

3000 SERIES

34,944

\$0.26000

\$9,085,44

TOTAL DUE:

\$9,085,44

TERMS NET 30 DAYS

COMMENTS:

PROVISIONAL BILLING

.....

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



INVOICE # 980922 CUSTOMER # \$1545 BOL# 817

CONTRACT# 7917.010

SOLD TO: Chemeteo

3200 S. St. Louis St. Chicago, 1L 60623 INVOICE DATE 9/27/96
SHIPPED DATE 9/27/96
PACKING LIST 3339

967 6522

| ALLOY | DESCRIPTION | NETLBS | PRICE     | AMOUNT     |
|-------|-------------|--------|-----------|------------|
| 8722  | 2000 SERIES | 34,668 | \$0.25200 | \$8,736.34 |

TOTAL DUE:

\$8,736.34

TERMS NET 30 DAYS

COMMENTS:

PROVISIONAL BILLING

APPROVED BY:

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359

OCT-82-1996 11:21 FROM OLIN ACCOUNTING INDPLS



INVOICE # 960923 CUSTOMER # \$1545 BOL# 816

SHIPPED DATE
PACKING LIST

INVOICE DATE

9/26/96 3336

CONTRACT# 7917.010

SOLD TO:

printed 06/01/2011 11:04AM by Luttie.Boarman p. 246/361

Chemetoo

3200 S. St. Louis St. Chicago, IL 60623 96 I 0523

| ALLOY | DESCRIPTION | NET LBS | PRICE     | AMOUNT     |
|-------|-------------|---------|-----------|------------|
| 8722  | 2000 SERIES | 11,576  | \$0.25200 | \$2,917.15 |
| 8722  | 6000 SERIES | 22,908  | \$0,25200 | \$5,772.82 |

TOTAL DUE:

\$8,689.97

TERMS NET 30 DAYS

COMMENTS:

PROVISIONAL BILLING

APPROVED BY: PARTY

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



960924 **INVOICE#** CUSTOMER # (\$1545

813

CONTRACT#

BOL#

7917.010

INVOICE DATE 9/25/98

SHIPPED DATE 9/25/96

PACKING LIST

3334

96 I assuf

SOLD TO: Chemetoo

3200 S. St. Louis St. Chicago, IL 60623

ALLOY DESCRIPTION **NET LBS** 

PRICE

AMOUNT

8722 6000 SERIES

34,464

\$0.25200

\$8,684.93

TOTAL DUE:

\$8,684.93

TERMS **NET 30 DAYS** 

COMMENTS:

PROVISIONAL BILLING

APPROVED BY:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



INVOICE #

961013 CUSTOMER # \$1545

BOL# CONTRACT# 841

7917.010

SOLD TO:

Chemetco

3200 S. St. Louis St. Chicago, IL 60623

INVOICE DATE 10/10/96

SHIPPED DATE

10/10/96

PACKING LIST

3373

96 9 0570

| ALLOY | DESCRIPTION | NET LBS | PRICE     | AMOUNT     |
|-------|-------------|---------|-----------|------------|
| 8722  | 2000 SERIES | 34,432  | \$0,26000 | \$8,952,32 |

TOTAL DUE:

\$8,952.32

TERMS **NET 30 DAYS** 

COMMENTS:

PROVISIONAL BILLING

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359

TO

FINANCIAL



INVOICE # 961014 CUSTOMER# \$1545 BOL#

CONTRACTS

7917.010

Chemetoo

3200 S. St. Louis St. Chicago, IL 60623

INVOICE DATE 10/7/96

SHIPPED DATE **PACKING LIST** 

10/7/96

3369

| ALLOY | DESCRIPTION | NET LBS | PRICE     | AMOUNT     |
|-------|-------------|---------|-----------|------------|
| 8722  | 3000 SERIES | 33,550  | \$0.26000 | \$8,723.00 |

TOTAL DUE:

\$8,723.00

TERMS **NET 30 DAYS** 

SOLD TO:

COMMENTS:

PROVISIONAL BILLING

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359

OCT-25-1996 11:18 FROM OLIN ACCOUNTING INDPLS

INVOICE # 861018
CUSTOMER # \$1545.
BOL# 845
CONTRACT# 7917,010

SHIPPED DATE PACKING LIST

INVOICE DATE

10/15/96 10/15/96 3382

SOLD TO:

Chemetco

3200 S. St. Louis St. Chicago, IL 60623 96 20517

| ALLOY | DESCRIPTION |     | NET LBS | PRICE     | AMOUNT     |
|-------|-------------|-----|---------|-----------|------------|
| 8722  | 3000 SERIES | • . | 34,912  | \$0.26000 | \$9,077.12 |

TOTAL DUE:

\$9,077.12

TERMS NET 30 DAYS

COMMENTS:

PROVISIONAL BILLING

APPROVED BY: 285777

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359

# LIN BRASS - INDIANAPOLIS INDIANAPOLIS, INDIANA

INVOICE # ( 961019) CUSTOMER# 51545 > BOL 847

CONTRACT# 7917.010

SOLD TO:

Chemetoo ....

3200 S, St. Louis St. Chicago, -IL 60623

INVOICE DATE 40/16/96 SHIPPED DATE 10/16/98 PACKING LIST 3387

96 8-0518

| ALLOY | DESCRIPTION | NET LBS | PRICE     | AMOUNT     |
|-------|-------------|---------|-----------|------------|
| 8722  | 2000 SERIES | 33,224  | \$0.26000 | \$8,638.24 |

TOTAL DUE:

\$8,638.24

TERMS NET 30 DAYS

COMMENTS:

PROVISIONAL BILLING

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** P.O. BOX 92359



INVOICE# 961026

CUSTOMER # \$1545

BOLF

861

CONTRACT#

7917.010

SOLD TO:

Chemetoo

3200 S. St. Louis St. Chicago, IL 60623

INVOICE DATE (10/23/96

SHIPPED DATE **PACKING LIST** 

3400

| ALLOY | DESCRIPTION | NET LBS | PRICE     | AMOUNT       |
|-------|-------------|---------|-----------|--------------|
| 8722  | 3000 SERIES | 13,862  | \$0.26000 | · \$3,604.12 |
| 8722  | 2000 SERIES | 21,946  | \$0.26000 | \$5,705.96   |

**TOTAL DUE:** 

\$9,310.08

TERMS NET 30 DAYS

COMMENTS:

PROVISIONAL BILLING

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359

P. 96



INVOICE# 961028

CUSTOMER # \$1545

BOL# . CONTRACT#

858 7917.010

90LD TO:

Chemetoo

3200 9. St. Louis St. Chicago, IL 60623

10/22/96 INVOICE DATE SHIPPED DATE

10/22/96

**PACKING LIST** 

3396

96 9-05-31

| ALLOY | DESCRIPTION | NET LBS | PRICE     | AMOUNT     |
|-------|-------------|---------|-----------|------------|
| 8722  | 6000 SERIES | 33,812  | \$0.26000 | \$8,791.12 |

. TOTAL DUE:

\$8,791.12

YERMS NET 30 DAYS

COMMENTS:

PROVISIONAL BILLING

PLEASE REMIT TO: **OLIN BRASS - INDIANAPOLIS** P.O. BOX 92359



INVOICE# 991029

CUSTOMER # S1545

80L#

CONTRACT#

7917.010

SOLD TO:

Chemetoo

3200 S. St. Louis St.

Chicago, IL 60623

INVOICE DATE

SHIPPED DATE

10/24/96

**PACKING LIST** 

3401

| ALLOY | DESCRIPTION | NET LBS | PRICE     | AMOUNT     |
|-------|-------------|---------|-----------|------------|
| 8722  | 3000 SERIES | 33,982  | \$0,26000 | \$8 835 32 |

TOTAL DUE:

\$8,835.32

TERMS NET 30 DAYS

COMMENTS:

PROVISIONAL BILLING

PLEASE REMIT TO:

**OLIN BRASS-INDIANAPOLIS** 

P.O. BOX 92359

OCT-29-1996 14:33 FROM OLIN ACCOUNTING INDPLS



INVOICE # 961030

CUSTOMER # \$1545

BOL# 863

CONTRACT# 7917.010

INVOICE DATE 10/25/96 SHIPPED DATE 10/25/96 PACKING LIST 3403

TO

SOLD TO: Chemetoo

printed 06/01/2011 11:04AM by Luttie.Boarman p. 255/361

3200 S. St. Louis St. Chicago, IL 60623

96 20532

| ALLOY | DESCRIPTION | NET LBS | PRICE     | AMOUNT     |
|-------|-------------|---------|-----------|------------|
| 8722  | 6000 SERIES | 29,304  | \$0,26000 | \$7,619,04 |
| 8722  | 2000 SERIES | 6,930   | \$0,26000 | \$1,801.80 |

TOTAL DUE:

\$9,420.84

TERMS NET 30 DAYS

COMMENTS:

PROVISIONAL BILLING

#DDDOWED BY

PLEASE REMIT TO:

**OLIN BRASS-INDIANAPOLIS** 

P.O. BOX 92359



INVOICE # (

BOL#

CUSTOMER #

CONTRACT#

7917.010

INVOICE DATE (11/1/96)

SHIPPED DATE

11/1/96

**PACKING LIST** 

3408

SOLD TO:

Chemetco

3200 S. St. Louis St.

Chicago, IL 60623

| ALLOY | DESCRIPTION | . NET LBS | PRICE     | AMOUNT     |
|-------|-------------|-----------|-----------|------------|
| 8722  | 2000 SERIES | 8,288     | \$0.26000 | \$2,154.88 |
| 8722  | 6000 SERIES | 24,810    | \$0.26000 | \$6,450.60 |

TERMS NET 30 DAYS

COMMENTS:

PROVISIONAL BILLING

**TOTAL DUE:** 

\$8,605.48

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



INVOICE # ( 961105

CUSTOMER # BQL#

856

CONTRACT#

7917.010

SOLD TO:

Chemetco

3200 S. St. Louis St. Chicago, IL 60623

INVOICE DATE

11/6/96

SHIPPED DATE

11/6/96

**PACKING LIST** 

3418

**ALLOY** 

DESCRIPTION

NET LBS

PRICE

**AMOUNT** 

8722

2000 SERIES

35,140

\$0.26000

\$9,136.40

**TOTAL DUE:** 

\$9,136.40

TERMS NET 30 DAYS

COMMENTS:

PROVISIONAL BILLING

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



INVOICE #

CUSTOMER # \$1545

BOL#

854

CONTRACT#

7917.010

SOLD TO:

Chemetco

3200 S. St. Louis St.

Chicago, IL 60623

INVOICE DATE

11/5/96

SHIPPED DATE

11/5/96

**PACKING LIST** 

3417

| ALLOY | DESCRIPTION | NET LBS | PRICE     | ТИИОМА     |
|-------|-------------|---------|-----------|------------|
| 8722  | 3000 SERIES | 15,112  | \$0.26000 | \$3,929.12 |
| 8722  | 2000 SERIES | 17,132  | \$0.26000 | \$4,454.32 |

**TOTAL DUE:** 

\$8,383.44

TERMS NET 30 DAYS

**COMMENTS:** 

PROVISIONAL BILLING

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



INVOICE #

INVOICE # 961110 CUSTOMER # \$1545

BOL#

859

CONTRACT#

7917.010

INVOICE DATE

11/7/96

SHIPPED DATE

11/7/96

PACKING LIST 3

3424

رَجُ

SOLD TO:

Chemetco

16400 South Lanthrop

Harvey, IL 60426

96 KOSUS

| ALLOY | DESCRIPTION | NET LBS | PRICE     | TNUOMA     |
|-------|-------------|---------|-----------|------------|
| 8722  | 6000 SERIES | 12,682  | \$0.26000 | \$3,297.32 |
| 8722  | 3000 SERIES | 18,368  | \$0.26000 | \$4,775.68 |

TOTAL DUE:

\$8,073.00

TERMS NET 30 DAYS

COMMENTS:

PROVISIONAL BILLING

ADDDOVED BY:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.D. BOX 92359



INVOICE # 961119 CUSTOMER # \$1545

BOL#

882

CONTRACT# 7917,010

INVOICE DATE

11/27/96

SHIPPED DATE

11/27/96

PACKING LIST 3452

SOLD TO: Chemetoo

16400 South Lanthrop

Harvey, IL 60426

96×0518

| ALLOY | DESCRIPTION | NET LBS | PRICE     | AMOUNT     |
|-------|-------------|---------|-----------|------------|
| 8722  | 2000 SERIES | 32,136  | \$0.24750 | \$7,953.66 |

TOTAL DUE:

\$7,953.66

TERMS NET 30 DAYS

COMMENTS:

PROVISIONAL BILLING

APPROVED BY:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



print<del>q</del>d 06/01/2011 11:04AM by Luttie.Boar<del>man p</del>

## LIN BRASS - INDIANAPOLIS

INDIANAPOLIS, INDIANA

INVOICE#

CUSTOMER # \$1545

BOL#

880

CONTRACT# 7

7917.010

SOLD TO:

Chemetoo

16400 South Lanthrop

Harvey, IL 60426

INVOICE DATE 11/25/96 SHIPPED DATE 11/25/96 PACKING UST 3450

π

96K 8577 05 19

| ALLOY | DESCRIPTION | NET LBS | PRICE     | AMOUNT     |
|-------|-------------|---------|-----------|------------|
| 8722  | 3000 SERIES | 11,970  | \$0.24750 | \$2,962.58 |
| 8722  | 6000 SERIES | 21,624  | \$0.24750 | \$5,351.94 |

**TOTAL DUE:** 

\$8,314,52

TERMS NET 30 DAYS

COMMENTS:

PROVISIONAL BILLING

APPROVED BY:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359

LIN BRASS-INDIANAPOLIS

INDIANAPOLIS, INDIANA

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INVOICE #

961202

CUSTOMER #

\$15/15

BOL#

886

CONTRACT#

**VERBAL** 

Chan

Chemetco

16400 South Lanthrop .

Harvey, IL 60426

INVOICE DATE

12/4/96

SHIPPED DATE

12/4/96

**PACKING LIST** 

3454

96.20501

ALLOY

SOLD TO:

DESCRIPTION

**NET LBS** 

PRICE

**TRUOMA** 

8722

2000 SERIES

35,208

\$0.28000

\$9,858.24

**TOTAL DUE:** 

\$9,858.24

TERMS NET 30 DAYS

COMMENTS:

PROVISIONAL BILLING

APPROVED BY

PLEASE REMIT TO:

OLÍN BRASS - INDIANAPOLIS

P.O. BOX 92359



INVOICE #

CUSTOMER # (\$1545 BOL#

885

VERBAL

CONTRACT#

INVOICE DATE SHIPPED DATE

12/4/96

PACKING LIST

3455

SOLD TO:

Chemetco

16400 South Lanthrop

Harvey, IL 60426

9630502

**ALLOY** 

DESCRIPTION

NET LBS

PRICE

**AMOUNT** 

8722

3000 SERIES

33,564

\$0.28000

\$9,397.92

TOTAL DUE:

\$9,397.92

TERMS NET 30 DAYS

COMMENTS:

PROVISIONAL BILLING

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



# LIN BRASS - INDIANAPOLIS

#### INDIANAPOLIS, INDIANA

INVOICE #

DEC-26-1996 13:06 FROM

CUSTOMER # (\$4569)

BOL#

898

CONTRACT#

VERBAL

SOLD TO:

840 Delhusy Ave

840 Deliway Ave.

Cincinnati, OH 45229 1/04/50

.

7.7

INVOICE DATE 12/11/96
SHIPPED DATE 12/11/98
PACKING LIST 3471

9670504

| ALLOY | DESCRIPTION | NET LBS | PRICE     | AMOUNT     |
|-------|-------------|---------|-----------|------------|
| 8722  | 2000 SERIES | 5,728   | \$0.29250 | \$1,874.86 |
| 8722  | 6000 SERIES | 15.764  | \$0.29250 | \$4,610.97 |

TOTAL DUE:

\$6,285.83

TERMS NET 30 DAYS

COMMENTS:

PROVISIONAL BILLING

APPROVED BY:

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359



## LIN BRASS - INDIANAPOLIS

#### INDIANAPOLIS, INDIANA

INVOICE# < 961208

CUSTOMER # 54569

899

CONTRACT#

**VERBAL** 

SOLD TO:

. BOL#

eleteth M.B.M

840 Deliway Ave.

Cincinnati, OH 45229 Courseles

INVOICE DATE SHIPPED DATE

12/12/96

**PACKING LIST** 

3472

96 20505

ALLOY

DESCRIPTION

**NET LBS** 

PRICE

AMOUNT

8722

3000 SERIES

34,254

\$0.29250

\$10,019.30

TOTAL DUE:

\$10,019.30

TERMS NET 30 DAYS

COMMENTS:

PROVISIONAL BILLING

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



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#### LIN BRASS - INDIANAPOLIS

INDIANAPOLIS, INDIANA

INVOICE # 961211

CUSTOMER# S1545

BOL#

900

CONTRACT# VERBAL

SOLD TO:

Chemetoo

16400 South Lanthrop

Harvey, IL 60426

(1)

INVOICE DATE 12/19/98

SHIPPED DATE

12/19/96

PACKING LIST

3488

96 20509

| ALLOY |  |
|-------|--|
|       |  |

DESCRIPTION

NET LBS

PRICE

**AMOUNT** 

8722

3000 SERIES

34,388

\$0.29250

\$10.058.49

TOTAL DUE:

\$10,058.49

TERMS NET 30 DAYS

COMMENTS:

PROVISIONAL BILLING

APPROVED BY:

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359



JAN-02-1997 08:16 FROM OLIN ACCOUNTING INDPLS

INVOICE #

SOLD TO:

CUSTOMER #

CONTRACT#

898

898 VERBAL

Chemetco

16400 South Lanthrop Harvey, IL 60426 INVOICE DATE

SHIPPED DATE
PACKING LIST

12/18/96 12/18/96 3481

96 20510

| ALLOY | DESCRIPTION | NET LBS | PRICE     | AMOUNT |
|-------|-------------|---------|-----------|--------|
| 8722  | 2000 SERIES | 32,486  | \$0.29250 |        |

TOTAL DUE:

\$9,502.16

TERMS NET 30 DAYS

COMMENTS:

PROVISIONAL BILLING

APPROVED BY:

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359



INVOICE #

CUSTOMER # S1545 BOL# 905

CONTRACT# VERBAL INVOICE DATE (

12/27/96

SHIPPED DATE

12/27/96

**PACKING LIST** 

3492

SOLD TO:

Chemetoo

16400 South Lanthrop

Harvey, IL 60426

9620514 .OU

| ALLOY | DESCRIPTION | net les | PRICE     | THUOMA     |
|-------|-------------|---------|-----------|------------|
| 8722  | 2000 SERIES | 33,362  | \$0,29250 | \$9,758.39 |

TOTAL DUE:

\$9,758.39

TERMS NET 30 DAYS COMMENTS:

PROVISIONAL BILLING



्र सम्बद्ध संस्था

INVOICE # ( 870114

CUSTOMER # \$1545

BOL#

CONTRACT#

VERBAL

SOLD TO:

Chemetoo

16400 South Lanthrop

Harvey, IL 60426

INVOICE DATE 01/27/97

SHIPPED DATE

01/21/97

**PACKING LIST** 

TO

3514

97A0574

ALLOY

DESCRIPTION

NET LBS

PRICE

**AMOUNT** 

8722

2000 SERIES FURNACE SCREENINGS

32,310

\$0.37500

\$12,116.25

**TOTAL DUE:** 

\$12,116.25

TERMS NET 30 DAYS COMMENTS:

APPROVED BY:

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359



INVOICE # (

CUSTOMER #

BOL#

CONTRACT#

VERBAL

SOLD TO: Chemetoo

16400 South Lanthrop

Harvey, IL 60426

INVOICE DATE (

01/27/97

SHIPPED DATE

01/22/97

PACKING LIST

3521

97A0575

| ALLOY | DESCRIPTION                    | NET LBS | PRICE     | AMOUNT      |
|-------|--------------------------------|---------|-----------|-------------|
| 8722  | 3000 SERIES FURNACE SCREENINGS | 35 044  | \$0.37500 | \$13,141.50 |

**TOTAL DUE:** 

\$13,141.50

erasi,

TERMS NET 30 DAYS COMMENTS:

PLEASE REMITTO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



INVOICE # 970119
CUSTOMER # \$1545
BOL# 938
CONTRACT# VERBAL

INVOICE DATE 01/30/97
SHIPPED DATE 01/23/97
PACKING LIST 3527

SOLD TO:

Chemetoo

16400 South Lanthrop Harvey, IL 60426 97A 0517

| ALLOY | DESCRIPTION                    | NET LBS | PRICE     | AMOUNT      |
|-------|--------------------------------|---------|-----------|-------------|
| 8722  | 3000 SERIES FURNACE SCREENINGS | 34,034  | \$0.37500 | \$12,762.75 |

TOTAL DUE:

\$12,762.75

TERMS NET 30 DAYS

COMMENTS:

APPROVED BY: 24

PLEASE REMIT TO:
OLIN BRASS - INDIANAPOLIS
P.O. BOX 92359
CHICAGO, IL 60675-2359

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INVOICE# 970120 CUSTOMER ( BOL#

CONTRACT# VERBAL

SOLD TO:

printed 06/01/2011 11:04AM by Luttie.Boarman p. 272/361

Chemetoo

16400 South Lanthrop Harvey, IL 60426

01/30/97 INVOICE DATE ( SHIPPED DATE 01/24/97 3529 **PACKING LIST** 

TO

974.0518

| ALLOY | DESCRIPTION   | NET LBS | PRICE     | AMOUNT      |
|-------|---------------|---------|-----------|-------------|
| 0929  | TIN SKIMMINGS | 41,498  | \$1,50000 | \$62,247.00 |

TOTAL DUE:

\$62,247.00

TERMS NET 30 DAYS COMMENTS:

PLEASE REMIT TO: OLIN BRASS - INDIANAPOLIS P.O. BOX 92359 CHICAGO, IL 60675-2359



ENVOICE # 970124
CUSTOMER # S1545
BOL# 944
CONTRACT# VERBAL

INVOICE DATE 01/29/97
SHIPPED DATE 01/29/97
PACKING LIST 3535

SOLD TO:

Chemetoo

16400 South Lanthrop Harvey, IL 60426 0.573

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT     |
|-------|-------------------------------|---------|-----------|------------|
| 8722  | 6000 SERIES FURNACE SKIMMINGS | 9,096   | \$0.37500 | \$3,411.00 |
| 8722  | 3000 SERIES FURNACE SKIMMINGS | 17,296  | \$0.37500 | \$6,486.00 |

**TOTAL DUE:** 

\$9,897.00

TERMS NET 30 DAYS COMMENTS:

APPROVED BY:

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359

CHICAGO, IL 60675-2359

TOTAL P.02

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INVOICE # 970208
CUSTOMER # \$1545
BOL# 976
CONTRACT# VERBAL

INVOICE DATE 02/17/97
SHIPPED DATE 02/11/97
PACKING LIST 3566

SOLD TO:

Chemetoo

16400 South Lanthrop Harvey, IL 60426 97B0507

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | I AMOUNT    |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 6000 SERIES FURNACE SKIMMINGS | 2,528   | \$0.37500 | \$948.00    |
| 8722  | 3000 SERIES FURNACE SKIMMINGS | 31,158  | \$0,37500 | \$11,684.25 |

TOTAL DUE:

\$12,632.26

1246 5 134

English (2)

TERMS NET 30 DAYS COMMENTS:

ADDROVED BY:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 82359

CHICAGO, IL 60675-2359

\$12732.5



INVOICE # 970211 CUSTOMER # 61545

BOLW

977

CONTRACTS VERBAL

INVOICE DATE 2/21/97
SHIPPED DATE 02/19/97
PACKING LIST 3574

TO

9780570

SOLD TO: Chemetoo

16400 South Lanthrop Harvey, IL 60426

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 3000 SERIES FURNACE SKIMMINGS | 34,760  | \$0,42500 | \$14,773.00 |

TOTAL DUE:

\$14,773.00

**श**ित्र सन्त्रीर

TERMS NET 39 DAYS COMMENTS:

APPROVED BY:



INVOICE # 970217

CUSTOMER # (\$1545 BOL#

984

**VERBAL** CONTRACTS

SOLD TO:

Chemetco

16400 South Lanthrop Harvey, IL 60426

INVOICE DATE SHIPPED DATE 02126/97 02/21/97

**PACKING LIST** 

3583

9780577

**ALLOY** 

DESCRIPTION

**NET LBS** 

PRICE

AMOUNT

8722

2000 SERIES FURNACE SKIMMINGS

34,386

\$0.42500

\$14,592,80

TOTAL DUE:

TERMS NET 30 DAYS

COMMENTS:

PLEASE RENIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359

CHICAGO, IL 60679-2359



INVOICE # 970219
CUSTOMER # \$1545
BOL# 979
CONTRACT# VERBAL

INVOICE DATE 02/26/97
SHIPPED DATE 02/20/97
PACKING LIST 3576

SOLD TO:

Chemetoo

16400 South Lanthrop Harvey, IL 60426 9760516

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT     |
|-------|-------------------------------|---------|-----------|------------|
| 8722  | 3000 SERIES FURNACE SKIMMINGS | 35,384  | \$0.42500 | 315,038.20 |

TOTAL DUE:

\$15,038.20

TERMS NET 30 DAYS

COMMENTS:

APPROVED BY:

PLEASE RENIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359

CHICAGO, IL 60675-2359

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INVOICE # 97022 CUSTOMER # \$1545

BOL#

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CONTRACT# VERBAL

INVOICE DATE

SHIPPED DATE 02/27/5

PACKING LIST 3593

9760504

SOLD TO: Chemetoo

16400 South Lanthrop Harvey, IL 60426

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 3000 SERIES FURNACE SKIMMINGS | 34,792  | \$0.42500 | \$14,788.60 |

TOTAL DUE:

\$14,786.60

TERMS NET 30 DAYS

COMMENTS:

APPROVED BY:\_

PLEASE REMIT TO: OLIN BRASS - INDIANAPOLIS. P.O. BOX 92359

CHICAGO, IL 60675-2359



INVOICE #

970302

CUSTOMER # \$1545 BOL#

CONTRACT#

994

**VERBAL** 

INVOICE DATE (03/10/97

SHIPPED DATE

03/03/97

**PACKING LIST** 

3596

SOLD TO:

Chemetoo

16400 South Lanthrop

Harvey, IL 60428

97C 0.50/

**ALLOY** 

DESCRIPTION

**NET LBS** 

PRICE

AMOUNT

8722

3000 SERIES FURNACE SKIMMINGS

34,894

\$0.42500

\$14,829.95

TOTAL DUE:

\$14,829.95

TERMS NET 30 DAYS COMMENTS:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



INVOICE # 970303 CUSTOMER # \$1545

BOU#

998

CONTRACT#

VERBAL

SQLD TO:

Chemetoo

16400 South Lanthrop Harvey, IL 60426

INVOICE DATE (03/10/97)

SHIPPED DATE

03/04/97

**PACKING LIST** 

3600

97C0502

**ALLOY** 

DESCRIPTION

**NET LBS** 

PRICE

AMOUNT

8722

2000 SERIES FURNACE SKIMMINGS

34,424

\$0,42500

\$14,630.20

**TOTAL DUE:** 

TERMS NET 30 DAYS COMMENTS:

APPROVED BY:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



INVOICE # CUSTOMER # S1545

BOL# CONTRACT#

SOLD TO:

1000

**VERBAL** 

Chemetco

16400 South Lanthrop Harvey, IL 60426

INVOICE DATE 03/10/97 SHIPPED DATE 03/05/97 **PACKING LIST** 3604

9700503

| ALLOY | DESCRIPTION                   | NET LOS | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 6000 SERIES FURNACE SKIMMINGS | 33,688  | \$0.42500 | \$14,402.40 |

TOTAL DUE:

\$14,402,40

TERMS NET 30 DAYS COMMENTS:

APPROVED BY:

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359



INDIANAPOLIS, INDIANA

INVOICE # 970305 CUSTOMER # \$1545

BOL#
CONTRACT#

1001 VERBAL INVOICE DATE

03/10/97

SHIPPED DATE
PACKING LIST

03/06/97 3605

SOLD TO: Chemetoo

16400 South Lanthrop Harvey, IL 60426 97 C-050g

| _ | ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT      |
|---|-------|-------------------------------|---------|-----------|-------------|
|   | 8722  | 2000 SEREIS FURNACE SKIMMINGS | 35,364  | \$0.42500 | \$15,029.70 |

TOTAL DUE:

\$15,029.70

TERMS NET 30 DAYS COMMENTS:

APPROVED BY:

PLEASE REMIT TO:
OLIN BRASS - INDIANAPOLIS
P.O. BOX 92359



CUSTOMER # \$1545
BOLS 1008
CONTRACTS VERBAL

INVOICE DATE 03/13/97 SHIPPED DATE 03/13/97 PACKING LIST 3613

SOLD TO:

Chemetoo

16400 South Lanthrop Harvey, IL 60426 9700510

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 2000 SERIES FURNACE SKIMMINGS | 33,058  | \$0.40000 | \$13,223.20 |

TOTAL DUE:

\$13,223,20

TERMS NET 30 DAYS COMMENTS:

APPROVED BY:

PLEASE REMIT TO:
OLIN BRASS - INDIANAPOLIS
P.O. BOX 92359
CHICAGO, IL 60675-2359

TOTAL P.01 1 V

P.03



INVOICE # 970310 CUSTOMER # \$1545 BOL# 1008

VERBAL

SOLD TO:

CONTRACT#

Chemetco

16400 South Lanthrop Harvey, IL 60426 SHIPPED DATE 03/12/97
PACKING LIST 3612

97C0509

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 3000 SERIES FURNACE SKIMMINGS | 33,868  | \$0.40000 | \$13,547.20 |

TOTAL DUE:

\$13,547.20

TERMS NET 30 DAYS COMMENTS:

APPROVED BY: XYM



INVOICE # CUSTOMER# S1545 BOL# 1012 CONTRACT#

INVOICE DATE ( 03/20/97/ SHIPPED DATE **PACKING LIST** 3615

SOLD TO:

Chemetco

16400 South Lanthrop Harvey, IL 60426

**VERBAL** 

9700512

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 2000 SERIES FURNACE SKIMMINGS | 34,370  | \$0.40000 | \$13,748.00 |

TOTAL DUE:

\$13,748.00

TERMS NET 30 DAYS COMMENTS:



INVOICE # 970316
CUSTOMER # S1545
BOL# 1016
CONTRACT# VERBAL

INVOICE DATE 03/20/97
SHIPPED DATE 03/18/97
PACKING LIST 3618

TO

SOLD TO:

Chemetoo

16400 South Lanthrop Harvey, IL 60426 97C 0515

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 6000 SERIES FURNACE SKIMMINGS | 34,458  | \$0.40000 | \$13,783.20 |

TOTAL DUE:

\$13,783.20

TERMS NET 30 DAYS

APPROVED BY: THY



INVOICE # 970317.
CUSTOMER # \$1545
BOL# 1020

CONTRACT# VERBAL

INVOICE DATE 03/24/97
SHIPPED DATE 03/19/97
PACKING LIST 3623

SOLD TO:

Chemetoo

16400 South Lanthrop Harvey, IL 60426 97C0516

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | ANOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 3000 SERIES FURNACE SKIMMINGS | 35.720  | \$0,40000 | \$14,288.00 |

TOTAL DUE:

\$14,288.00

TERMS NET 30 DAYS COMMENTS:

APPROVED BY: DYTT



INVOICE #

970319

CUSTOMER# \$1545 BOL#

1024

CONTRACT# **VERBAL**  INVOICE DATE 03/24/97

SHIPPED DATE

**PACKING LIST** 

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3628

SOLD TO:

Chemetoo

16400 South Lanthrop

Harvey, IL 60426

97C 0518

**ALLOY** 

DESCRIPTION

**NET LBS** 

PRICE

**AMOUNT** 

8722

printed 06/01/2011 11:04AM by Luttie-Boarman p. 288/361

2000 SERIES FURNACE SKIMMINGS

32,400

\$0.40000

\$12,960.00

TOTAL DUE:

\$12,960.00

TERMS NET 30 DAYS COMMENTS:

PLEASE REMIT TO: **OLIN BRASS - INDIANAPOLIS** P.O. BOX 92359

CHICAGO, IL 60675-2359

TOTAL P.09



INVOICE # 970320 CUSTOMER# S1545

BOL#

CONTRACTS VERBAL

INVOICE DATE (\_03/28/97\_)

SHIPPED DATE

03/21/97

PACKING LIST

SOLD TO:

printed 06/01/2011 11:04AM by Luttie.Boarman p. 289/361

Chemetoo

16400 South Lanthrop

Harvey, IL 60426

9700519

ALLOY

DESCRIPTION

**NET LBS** 

PRICE

**AMOUNT** 

8722

3000 SERIES FURNACE SKIMMINGS

34,042

\$0,40000

\$13,616.80

**TOTAL DUE:** 

\$13,616.80

TERMS NET 30 DAYS COMMENTS:

APPROVED BY:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



CUSTOMER # \$1545
BOL# 1060
CONTRACT# VERBAL

SHIPPED DATE 04/10/97
PACKING LIGT 3669

SOLD TO:

Chemetoo

16400 South Lanthrop Harvey, IL, 60426 9700570

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 6000 SERIES FURNACE SKIMMINGS | 4,890   | \$0,40000 | \$1,956.00  |
| 8722  | 3000 SERIES FURNACE SKIMMINGS | 28,984  | \$0.40000 | \$11,593.60 |

TOTAL DUE:

\$13,549.60

TERMS NET 30 DAYS

COMMENTS:

APPROVED BY:

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359

CHICAGO, IL 60675-2359

TOTAL P.18



INVOICE # 970405
CUSTOMER # \$1545
BOL# 1048
CONTRACT# VERBAL

INVOICE DATE 4/11/97 SHIPPED DATE 04/02/97 PACKING LIST 3655

SOLD TO:

Chemetoo

16400 South Lanthrop Harvey, IL 60426 970 050-

| ALLOY | DESCRIPTION                   | NET LBS | PRIČE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 2000 SERIES FURNACE SKIMMINGS | 34,158  | \$0.40000 | \$13,663.20 |

TOTAL DUE:

\$13,663.20

TERMS NET 30 DAYS COMMENTS:

APPROVED BY:

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS P.O. BOX 92359



INVOICE # 970496
CUSTOMER # \$1545
BOL# 1050
CONTRACTW VERBAL

INVOICE DATE 4/11/97
SHIPPED DATE 04/03/97
PACKING LIST 3656

SOLD TO:

Chemetoo

16400 South Lenthrop Harvey, IL 60426 9700503

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNŤ      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 3000 SERIES FURNACE SKIMMINGS | 34,596  | \$0,40000 | \$13,838.40 |

TOTAL DUE:

\$13,838.40

TERMS NET 30 DAYS COMMENTS:

APPROVED BY:

PLEASE RENT TO:
OLIN BRASS - INDIANAPOLIS
P.O. BOX 92359
CHICAGO, IL 60675-2359



INVOICE #

CUSTOMER # \$1545 BOL#

1052 CONTRACT# **VERBAL**  INVOICE DATE 4/11/97 SHIPPED DATE

04/04/97

**PACKING LIST** 3659

SOLD TO:

Chemetoo

16400 South Lanthrop Harvey, IL 60426

9700506

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 2000 SERIES FURNACE SKIMMINGS | 33,218  | \$0.40000 | \$13,287.20 |

TOTAL DUE:

\$13,287.20

TERMS NET 30 DAYS COMMENTS:

PLEASE REMIT TO: OLIN BRASS - INDIANAPOLIS P.O. BOX 92359 CHICAGO, IL 60875-2359

P.87



USTOMER # \$70410
CUSTOMER # \$1545
BOL# 1054
CONTRACT# VERBAL

SHIPPED DATE 04/07/97
PACKING LIST 3660

SOLD TO:

Chemetco

16400 South Lanthrop Harvey, IL 60428 9710507

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 3000 SERIES FURNACE SKIMMINGS | 35.556  | \$0.40000 | \$14,222.40 |

TOTAL DUE:

\$14,222,40

TERMS NET 30 DAYS COMMENTS:

APPROVED BY:

PLEASE REMIT TO: OLIN BRASS - INDIANAPOLIS P.O. BOX 92359 CHICAGO, IL 60675-2359



INVOICE # 970411 CUSTOMER # (\$1545

BOL#

1059

CONTRACT# VERBAL

INVOICE DATE ( SHIPPED DATE

04/09/97 PACKING LIST

3666

SOLD TO:

Chemetoo

16400 South Lanthrop

Harvey, IL 60426

9700508

| ALLOY | DESCRIPTION                   |   | NET LBS | PRICE     | THUCKA      |
|-------|-------------------------------|---|---------|-----------|-------------|
| 8722  | 2000 SERIES FURNACE SKIMMINGS | * | 33,250  | \$0,40000 | \$13,300,00 |

**TOTAL DUE:** 

\$13,300.00

TERMS NET 30 DAYS COMMENTS:

PLEASE REMIT TO: **OLIN BRASS - INDIANAPOLIS** P.O. BOX 92359 CHICAGO, IL 60675-2359



INVOICE# CUSTOMER # 81545 1065

CONTRACT# **VERBAL** 

Chemetoo SOLD TO:

> 16400 South Lanthrop Harvey, IL 60428

INVOICE DATE ( 4/21/97 SHIPPED DATE 4/14/97 PACKING LIST 3674

9710511

P.02

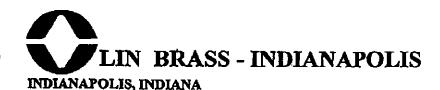
| ALLOY        | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT     |
|--------------|-------------------------------|---------|-----------|------------|
| 8 <b>722</b> | 2000 SERIES FURNACE SKIMMINGS | 7,306   | \$0.40000 | \$2,922.40 |
| 8722         | 6000 SERIES FURNACE SKIMMINGS | 24,768  | \$0.40000 | \$9,907.20 |

TOTAL DUE:

\$12,829.60

TERMS NET 30 DAYS COMMENTS:

PLEASE REMIT TO: **OLIN BRASS - INDIANAPOLIS** P.O. BOX 92359



INVOICE # 970412
CUSTOMER # \$1545
BOL# 1069
CONTRACT# VERBAL

SHIPPED DATE 4/16/97
PACKING LIST 3879

SOLD TO:

Chemetco

16400 South Lanthrop Harvey, IL 60426 971) 0512

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | TRUONILA    |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 2000 SERIES FURNACE SKIMMINGS | 34,474  | \$0,40000 | \$13,789.60 |

TOTAL DUE:

\$13,789.60

TERMS NET 30 DAYS COMMENTS:

APPROVED BY: WYTH

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359

P.02



INVOICE# 970416
CUSTOMER # \$1545
BOL# 1082
CONTRACT# VERBAL

SHIPPED DATE 04/23/97
PACKING LIST 3894

TO

SOLD TO:

Chemetoo

16400 South Lanthrop Harvey, IL 60426 971) 0517

| ALLOY | DESCRIPTION                   | NET LB9 | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 3000 SERIES FURNACE SKIMMINGS | 34,580  | \$0.40000 | \$13,832.00 |

34,580

TOTAL DUE:

\$13,832.00

TERMS NET 30 DAYS COMMENTS:

APPROVED BY:

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359



INVOICE #

SOLD TO:

CUSTOMER # (\$1545

BOL#

1093 **VERBAL** 

CONTRACT#

Chemetoo

16400 South Lanthrop

Harvey, IL 60426

INVOICE DATE SHIPPED DATE

PACKING LIST

3709

97D0519

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 2000 SERIES FURNACE SKIMMINGS | 35,872  | \$0.40000 | \$14,348.80 |

35,872

TOTAL DUE:

\$14,348,80

TERMS NET 30 DAYS

COMMENTS:

**PLEASE REMIT TO:** 

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359



INVOICE # 970421 CUSTOMER # \$1545

BOL# 1086 CONTRACT# VERBAL INVOICE DATE 6/01/07
SHIPPED DATE 4/24/97
PACKING LIST 3700

SOLD TO:

Chemetoo

16400 South Länthrop Harvey, IL 80426 9710501

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 2000 SERIES FURNACE SKIMMINGS | 32,770  | \$0.40000 | \$13,108.00 |

32,770

TOTAL DUE:

\$13,108.00

TERMS NET 30 DAYS

ADDDOVED BY

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359



INVOICE # 970422 CUSTOMER # \$1545 BOL# 1070

CONTRACT# VERBAL

INVOICE DATE 4/22/97 SHIPPED DATE 4/17/97 PACKING LIST 3881

SOLD TO:

Chemetoo

16400 South Lanthrop Harvey, IL 60426 9100500

| ALLOY | DESCRIPTION                   | NET LB\$ | PRICE     | AMOUNT      |
|-------|-------------------------------|----------|-----------|-------------|
| 8722  | 3000 SERIES FURNACE SKIMMINGS | 25,582   | \$0.40000 | \$10,232.80 |

25,582

TOTAL DUE:

\$10,232.80

TERMS NET 30 DAYS COMMENTS:

APPROVED RY

PLEASE REWIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359

CHICAGO, IL 60675-2359

TOTAL P.89



INVOICE # 970507 CUSTOMER # \$1548 BOL# 1108 CONTRACT#

INVOICE DATE SHIPPED DATE **PACKING LIST** 

(05/12/97) 05/08/97 3726

SOLD TO:

Chemetop

16400 South Lanthrop Harvey, IL 60426

VERBAL

97E0506

| ALLOY | DESCRIPTION                   | NET L89 | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 2000 SERIES FURNACE SKIMMINGS | 34,080  | \$0,40000 | \$13,632.00 |

34,080

TOTAL DUE:

\$13,632.00

TERMS NET 30 DAYS COMMENTS:

APPROVED BY:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



INVOICE # CUSTOMER # \$1545 BOF# 1100 CONTRACTS

VERBAL

INVOICE DATE (05/09/97 SHIPPED DATE 05/05/97 PACICINO LIST 3720

SOLD TO:

Chemetoo

16400 South Lanthrop Harvey, IL 60426

97E0508

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 2000 SERIES FURNACE SKIMMINGS | 32,580  | \$0,40000 | \$13,032.00 |

32,580

TOTAL DUE:

\$13,032.00

TERMS NET 30 DAYS COMMENTS:

APPROVED BY:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359

CHICAGO, IL 60675-2359

TOTAL P.07



INVOICE # ( 970510 CUSTOMER# (\$1545)

CONTRACT#

1116 **VERBAL** 

SOLD TO:

Chemetoo 18400 South Lanthrop Harvey, IL 60426

INVOICE DATE 5/15/97

SHIPPED DATE

5/13/97

**PACKING LIST** 3737

97E0503

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 2000 SERIES FURNACE SKIMMINGS | 6,464   | \$0.40000 | \$2,581.60  |
| 8722  | 6000 SERIES FURNACE SKIMMINGS | 27,418  | \$0.40000 | \$10,967.20 |

33,872

TOTAL DUE:

\$13,548.80

TERMS NET 30 DAYS

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



INVOICE # CUSTOMER # 1110 CONTRACTO VERBAL

INVOICE DATE 6/14/97 SHIPPED DATE 5/12/97 3732 **PACKING LIST** 

SOLD TO:

Chemetoo

 $\mathcal{N}_{\mathcal{B}_{2}}:$ 

18400 South Lanthrop Harvey, IL 60428

97E0511

CHICAGO, IL 60675-2359

| ALLOY        | DESCRIPTION  | NET LBS | PRICE                                  | AMOUNT      |
|--------------|--|---------|--|-------------|
| 8722         | 2000 SERIES FURNACE SKIMMINGS  | 33,364  | \$0.40000                              | \$13,345.60 |
|              | * (c)  |         |  |             |
| 1. 60 64     | s Biglion Call   |         |  |             |
| <b>4.</b>    | The Reserve Control of the Control o | 33,364  | TOTAL DUE:                             | \$13,345.60 |
| TERMS NET    | 130 DAYS   | + 5     |  | ,           |
| COMMENTS:    | er i de la servició d | 5.44.21 | PLEASE REMIT TO:<br>OLIN BRASS - INDIA | NABOLI IS   |
| APPROVED BY: | Differ   |         | P.O. BOX 92359<br>CHICAGO, IL 60675-   |             |

TOTAL P.04

MAY-29-1997 08:17 FROM DLIN ACCOUNTING INDPLS

70

FINANCIAL

P. 02



INVOICE # 970513
CUSTOMER # \$1545
BOL# 1124
CONTRACT# VERBAL

SHIPPED DATE 5/19/97
PACKING LIST 3748

SOLD TO:

Chemetco

16400 South Lanthrop Harvey, IL 60426 97E05/3

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | THUOMA      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 3000 SERIES FURNACE SKIMMINGS | 32,324  | \$0.40000 | \$12,929.60 |

32,324

TOTAL DUE:

\$12,929.60

TERMS NET 30 DAYS COMMENTS:

APPROVED BY: PYTY

PLEASE REMIT TO:
OLIN BRASS - INDIANAPOLIS
P.O. BOX 92359
CHICAGO, IL 60975-2359



INVOICE # 970515 CUSTOMER # 91545 BOL# 1129 CONTRACT# VERBAL

INVOICE DATE 5/22/97
SHIPPED DATE 5/20/97
PACKING LIST 3752

SOLD TO:

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Chemetco

16400 South Lanthrop Harvey, IL 60426 97E0515

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 2000 SERIES FURNACE SKIMMINGS | 32,262  | \$0.40000 | \$12,904.80 |

32,262

TOTAL DUE:

\$12,904.80

TERMS NET 30 DAYS

APPROVED BY:

PLEASE RENIT TO:
OLIN BRASS - INDIANAPOLIS
P.O. BOX 92359
CHICAGO, IL 60678-2359

P. 02

INVOICE # S1645 BOL#

INVOICE DATE 5/30/97 SHIPPED DATE

**PACKING LIST** 

5/27/97 3762

SOLD TO:

Chemetoo

CONTRACT#

16400 South Lanthrop Harvey, IL 60426

**VERBAL** 

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT     |
|-------|-------------------------------|---------|-----------|------------|
| 8722  | 2000 SERIES FURNACE SKIMMINGS | 18,122  | \$0.40000 | \$7,248.80 |

18,122

TOTAL DUE:

\$7,248.80

TERMS NET 30 DAYS

COMMENTS:

APPROVED BY:

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359



97 E0518

INVOICE # 970518
CUSTOMER # \$1545
BOL# 1142

SHIPPED DATE PACKING LIST

INVOICE DATE

5/30/97 5/28/97 3764

CONTRACT# VERBAL

SOLD TO:

Chemetco

16400 South Lanthrop Harvey, IL 60426

| ALLOY | DESCRIPTION                   | NET LOS | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 3000 SERIES FURNACE SKIMMINGS | 33.474  | \$0,40000 | \$13,389.60 |

33,474

**TOTAL DUE:** 

\$13,389.60

TERMS NET 30 DAYS COMMENTS:

ADDOMES DV.

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359



97E6519

INVOICE# ( 970519 CUSTOMER# (\$1545 BOL# CONTRACT# VERBAL

INVOICE DATE 5/30/97 SHIPPED DATE 5/29/97 **PACKING UST** 3767

ŒΤ

Chemetoo SOLD TO:

16400 South Lanthrop Harvey, IL 60426

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | ANOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 2000 SERIES FURNACE SKIMMINGS | 34,412  | \$0,40000 | \$13,764.80 |

34,412

TOTAL DUE:

TERMS NET 30 DAYS COMMENTS:

PLEASE REMIT TO: **OLIN BRASS - INDIANAPOLIS** P.O. BOX 92359 CHICAGO, IL 80675-2359

JUN-03-1997 13:24 FROM DLIN ACCOUNTING INDALS

TO

FINANCIAL

P. 02



INVOICE # 970622 CUSTOMER # S1545 BOL# 1148

CONTRACT# VERBAL

INVOICE DATE SHIPPED DATE PACKING LIST

-6/03/97 5-30-97 05/30/97

ST 3770

\$ 1545

SOLD TO:

Chemetoo

16400 South Lanthrop Harvey, IL 60426

| ALLOY | DESCRIPTION                   | NET LBS | PRICE      | AMOUNT      |
|-------|-------------------------------|---------|------------|-------------|
| 8722  | 3000 SERIES FURNACE SKIMMINGS | 33,996  | \$0.40000  | \$13,598.40 |
|       |                               |         | \          | $\times$    |
|       |                               | 33,996  | TOTAL DUE: | \$13,598.40 |

TERMS NET 30 DAYS COMMENTS:

APPROVED BY:

PLEASE REMIT TO: OLIN BRASS - INDIANAPOLIS P.O. BOX 92359 CHICAGO, IL 80675-2359

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|------------------------------|------------------------------|
| かまたの                         | From                         |
| Dept                         | Co.                          |
| Fax #                        | Phone #                      |
|                              | Fax #                        |



INVOICE # 970523 CUSTOMER# \$1545 BQL# 1150 CONTRACTS

**VERBAL** 

Chemetoo SOLD TO:

> 16400 South Lanthrop Harvey, IL 60426

INVOICE DATE GARAGE 5-30SHIPPED DATE 05/30/97

**PACKING LIST** 

3769

\$ 1545

| AMOUNT      | PRICE      | NET LBS | DESCRIPTION                   | ALLOY |
|-------------|------------|---------|-------------------------------|-------|
| \$8,648.80  | \$0.40000  | 21,622  | 2000 SERIES FURNACE SKIMMINGS | 8722  |
| \$4,931.20  | \$0.40000  | 12,328  | 3000 SERIES FURNACE SKIMMINGS | 8722  |
| X           | )          |         |                               |       |
| \$13,580.00 | TOTAL DUE: | 33,960  |                               |       |

TERMS NET 30 DAYS

COMMENTS:

PLEASE REMIT TO: -OLIN BRASS - INDIANAPOLIS P.O. BOX 92359 CHICAGO, IL 60675-2359



NVOICE # 970501 CUSTOMER # \$1545 BOL# 1158

CONTRACT# VERBAL

SOLD TO:

Chemetoo

16400 South Lanthrop Harvey, IL 60426 INVOICE DATE 06/11/97
SHIPPED DATE 6/05/97
PACKING LIST 3779

97F0503

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 2000 SERIES FURNACE SKIMMINGS | 33,924  | \$0.37500 | \$12,721.50 |

33,924

... ...

TOTAL DUE:

\$12,721.50

TERMS NET 30 DAYS

COMMENTS:

APPROVED BY:

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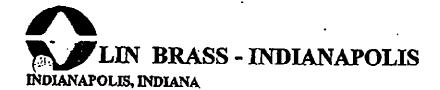
PLEASE REMIT TO:

**OLIN BRASS - ENDIANAPOLIS** 

P.O. BOX 92359

CHICAGO, R. 60675-2359

TOTAL P.07



INVOICE # 970802
CUSTOMER # \$1545
BOL# 1160
CONTRACT# VERBAL

INVOICE DATE 08/1/97
SHIPPED DATE 6/06/97
PACKING LIST 3784

SOLD TO:

Chemetoo

·18400 South Lanthrop Harvey, IL 60426 97 FUSOU

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 3000 SERIES FURNACE SKIMMINGS | 33,582  | \$0.37500 | \$12,593.25 |

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23.582

TOTAL DUE:

\$12,593.25

TERMS NET 30 DAYS COMMENTS:

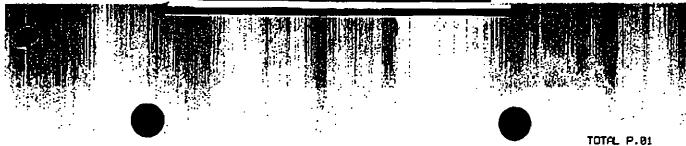
APPROVED BY:

PLEASE RENET TO:
OLIN BRASS - INDIANAPOLIS
P.O. BOX 92359
CHICAGO, IL 60675-2359

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Co.
Dept. Phone F

Pax #





INVOICE # 970607
CUSTOMER # \$1545
BOL# 1178
CONTRACT# VERBAL

SHIPPED DATE 6/12/97
PACKING LIST 3801

SOLD TO:

Chemetoo

16400 South Lanthrop Harvey, IL 60426 97F 0506

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 2000 SERIES FURNACE SKIMMINGS | 33,262  | \$0.37500 | \$12,473.25 |

33,262

TOTAL DUE:

\$12,473.25

TERMS NET 30 DAYS COMMENTS:

APPROVED BY: 24M

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359



INVOICE #

970613

CUSTOMER # S1545

1181

CONTRACT# **VERBAL** 

SOLD TO:

Chemetoo

16400 South Lanthrop Harvey, IL 60426

INVOICE DATE

SHIPPED DATE

**PACKING LIST** 

3803

97F0512

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 6000 SERIES FURNACE SKIMMINGS | 30,624  | \$0.33750 | \$10,335.60 |

30,624

TOTAL DUE:

\$10,335.60

TERMS NET 30 DAYS COMMENTS:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



INVOICE # 970703 CUSTOMER #/

BOL# CONTRACT#

1188 **VERBAL**  INVOICE DATE

7/10/97

SHIPPED DATE

7/03/97

**PACKING LIST** 

3810

SOLD TO:

Chemetoo

16400 South Lanthrop

Harvey, IL 60426

9760519

| ALLOY | DESCRIPTION                   | NET LAS | PRICE     | AMOUNT     |
|-------|-------------------------------|---------|-----------|------------|
| 8722  | 3000 SERIES FURNACE SKIMMINGS | 22,710  | \$0.33750 | \$7,864.63 |

22,710

**TOTAL DUE:** 

\$7,664.63

TERMS NET 30 DAYS COMMENTS:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359

JUL-17-1997 08:20 FROM DLIN ACCOUNTING INDPLS



INVOICE # 970704
CUSTOMER \$1545
BOL# 1195
CONTRACT# VERBAL

INVOICE DATE 7/14/97
SHIPPED DATE 7/09/97
PACKING LIST 3818

SOLD TO:

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Chemetoo

16400 South Lanthrop Harvey, IL 60426 976-0521

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 2000 SERIES FURANCE SKIMMINGS | 33,340  | \$0.33750 | \$11,252,25 |

33,340

TOTAL DUE:

\$11,252,25

TERMS NET 30 DAYS
COMMENTS;

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## LIN BRASS - INDIANAPOLIS

OLIN ACCOUNTING INDPLS

INDIANAPOLIS, INDIANA

INVOICE# CUSTOMER

BOLF CONTRACT#

**VERBAL** 

INVOICE DATE

7/14/97

SHIPPED DATE

7/10/97

**PACKING LIST** 

3820

SOLD TO:

Chemetco

16400 South Lanthrop Harvey, IL 60426

9760520

**ALLOY** 

DESCRIPTION

**NET LBS** 

PRICE

**TKUOMA** 

8722

3000 SERIES FURNACE SKIMMINGS

32,956

\$0,33750

\$11,122.65

32,956

TOTAL DUE:

\$11,122.65

TERMS NET 30 DAYS COMMENTS:

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359

CHICAGO, IL 60675-2359

TOTAL P.04



INVOICE # . 970707. CUSTOMER & \$1545

BOL#

1204

CONTRACT#

**VERBAL** 

SOLD TO:

Chemetoo

16400 South Lanthrop Harvey, IL 60426

INVOICE DATEC 7/21/97

SHIPPED DATE

7/16/97

**PACKING LIST** 

3828

97G0500

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 3000 SERIES FURNACE SKIMMINGS | 34,114  | \$0.33750 | \$11,513.48 |

34,114

TOTAL DUE:

TERMS NET 30 DAYS

COMMENTS:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359

JUL-24-1997 88:23 FROM DLIN ACCOUNTING INDPLS . TO



INVOICE # 970708
CUSTOMER # S1545
BOL# 1205
CONTRACT# VERBAL

INVOICE DATE 7/21/97
SHIPPED DATE 7/17/97
PACKING LIST 3829

SOLD TO:

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Chemetco

16400 South Lanthrop Harvey, IL 60426 9760503

| <b>T</b> | ALLOY | DESCRIPTION                   | NETLBS | PRICE     | AMOUNT     |
|----------|-------|-------------------------------|--------|-----------|------------|
| -        | 8722  | 2000 SERIES FURNACE SKIMMINGS | 18,018 | \$0.31500 | \$5,675.67 |
| ;        | 8722  | 6000 SERIES FURNACE SKIMMINGS | 15,828 | \$0.31500 | \$4,985.82 |

33,846

TOTAL DUE:

\$10,661.49

TERMS NET 30 DAYS COMMENTS:

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P.O. BOX 92359



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## LIN BRASS-INDIANAPOLIS

INDIANAPOLIS, INDIANA

INVOICE # 970709

CUSTOMER # (\$1545

BOL#

1203

CONTRACT# **VERBAL** 

SOLD TO:

Chemetco

16400 South Lanthrop

Harvey, IL 60426

INVOICE DATE 7/21/97

SHIPPED DATE

7/15/97

**PACKING LIST** 

3825

9760524

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 2000 SERIES FURNACE SKIMMINGS | 35,018  | \$0.33750 | \$12,156.08 |

36,018

TOTAL DUE:

\$12,156.08

TERMS NET 30 DAYS

**COMMENTS:** 

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PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359



INVOICE #

CUSTOMER#

BOL# CONTRACT#

1261 **VERBAL** 

970717

SOLD TO:

Chemetoo .

16400 South Lanthrop

Harvey, IL 60426

INVOICE DATE

SHIPPED DATE

**PACKING LIST** 

3847

976-0532

FINANCIAL

PRICE **AMOUNT** ALLOY DESCRIPTION NET LBS \$11,241.09 8722 \$0.31500 3000 SERIES FURNACE SKIMMINGS 35,686

35,688

TOTAL DUE:

\$11,241.09

TERMS NET 30 DAYS

COMMENTS:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



INVOICE # 97.0718

CUSTOMER # \$1545

BOL# 1237

CONTRACT#

INVOICE DATE SHIPPED DATE PACKING LIST

TO

8/04/94 7/28/97 3838

SOLD TO:

Chemetco

16400 South Lanthrop Harvey, IL 60426

VERBAL

976 0533

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | <br>AMOUNT  |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 2000 SERIES FURNACE SKIMMINGS | 35,762  | \$0,31500 | \$11,265.03 |

35,762

TOTAL DUE:

\$11,265.03

TERMS NET 30 DAYS

COMMENTS:

APPROVED BY: BYTYY

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359

AUG-84-1997 09:13 FROM OLIN ACCOUNTING INDPLS



INVOICE# (

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CUSTOMER # (\$1545.

BOL#

CONTRACT#

1233

VERBAL

SOLD TO: C

Chemetoo

16400 South Lanthrop Harvey, IL 60426 INVOICE DATE

7/3//97 8/04/07

SHIPPED DATE

7/25/97

PACKING LIST 3835

9760534

| ALLOY | DESCRIPTION                   | NET LBS | PRICE     | AMOUNT      |
|-------|-------------------------------|---------|-----------|-------------|
| 8722  | 3000 SERIES FURNACE SKIMMINGS | 33,938  | \$0.31500 | \$10,690.47 |

33,938

TOTAL DUE:

\$10,690.47

TERMS NET 30 DAYS

COMMENTS:

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200

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**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



INVOICE # 970807 BOL#

AUG-21-1997 16:18 FROM

CONTRACT#

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1306

**VERBAL** 

INVOICE DATE SHIPPED DATE PACKING LIST

8/18/97 8/13/97

3858

Chemetco · SOLD TO:

16400 South Lanthrop Harvey, IL 60426

9740508

| ALLÍOY | DESCRIPTION     | NET LBS | PRICE     | AMOUNT      |
|--------|-----------------|---------|-----------|-------------|
| 3538   | O. A. CAKE CUTS | 38,370  | \$0.46000 | \$17,650.20 |

OLIN ACCOUNTING INDPLS

38,370

TOTAL DUE:

\$17,650.20

TERMS NET 30 DAYS COMMENTS:

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OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359

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## LIN BRASS - INDIANAPOLIS

## INDIANAPOLIS, INDIANA

INVOICE #

CUSTOMER # (\$1545)

BOL#

1305

CONTRACT **VERBAL** 

SOLD TO:

Chemetoo

16400 South Lanthrop Harvey, IL 60426

INVOICE DATE (8/18/97

SHIPPED DATE

8/13/97

PACKING LIST 3857

TO

97/0509

| ALLOY | DESCRIPTION     | NET LBS | PRICE     | AMOUNT      |
|-------|-----------------|---------|-----------|-------------|
| 1458  | O. A. CAKE CUTS | 38,630  | \$0.87000 | \$33,808.10 |

38,630

TOTAL DUE:

\$33,608.10

TERMS NET 30 DAYS COMMENTS:

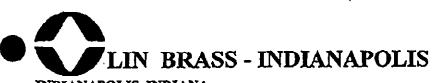
APPROVED BY: BR.SI

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359

AUG-28-1997 13:05 FROM OLIN ACCOUNTING INDPLS



INDIANAPOLIS, INDIANA

INVOICE # 970815 CUSTOMER # S1545 1310

INVOICE DATE 8/20/97 SHIPPED DATE **PACKING LIST** 

8/15/97 3862

CONTRACT#

**VERBAL** 

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Chemetco

16400 South Lanthrop Harvey, IL 60426

| ALLOY | DESCRIPTION                    | NET LBS | PRICE     | AMOUNT      |
|-------|--------------------------------|---------|-----------|-------------|
| 8722  | 2000 SERIES FURNACE SCREENINGS | 33,954  | \$0.31500 | \$10,695.51 |

33,954

**TOTAL DUE:** 

\$10,695.51

TERMS NET 30 DAYS COMMENTS:

PLEASE REMIT TO:

**OLIN BRASS-INDIANAPÓLIS** 

P.O. BOX 92359



INVOICE # 970817
CUSTOMER # \$1545
BOL# 1324
CONTRACT# VERBAL

INVOICE DATE 8/21/97
SHIPPED DATE 8/20/97
PACKING LIST 3871

SOLD TO:

<del>pr</del>inted <del>96</del>/9<del>1/20</del>11 11:04AM by Luttie.Boa<del>rmar</del>

Chemetoo

16400 South Lanthrop Harvey, IL 60426

| ALLOY | DESCRIPTION                    | NET LBS | PRICE     | AMOUNT      |
|-------|--------------------------------|---------|-----------|-------------|
| 8722  | 6000 SERIES FURNACE SCREENINGS | 33,752  | \$0.31500 | \$10,631,88 |

33,752

TOTAL DUE:

\$10,631.88

TERMS NET 30 DAYS COMMENTS:

APPROVED BY:

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359

AUG-28-1997 13:05 FROM DLIN ACCOUNTING INDPLS



INVOICE # CUSTOMER #

BOL#

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970821 \$1545 1317

CONTRACT#

VERBAL

TRACT# VERBA

Chemetco

16400 South Lanthrop Harvey, IL 60426 SHIPPED DATE 8/19/97
PACKING LIST 3869

10

9740518

| ALLOY | DESCRIPTION                    | NET LBS | PRICE     | AMOUNT      |
|-------|--------------------------------|---------|-----------|-------------|
| 8722  | 3000 SERIES FURNACE SCREENINGS | 33,772  | \$0.31500 | \$10,638.18 |

33,772

TOTAL DUE:

\$10,638.18

TERMS NET 30 DAYS

COMMENTS:

APPROVED BY:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



INVOICE # 970902 CUSTOMER # \$1545 BOL#

1353

**CONTRACT# VERBAL** 

INVOICE DATE SHIPPED DATE 3904 PACKING LIST

SOLD TO:

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Chemetoo 16400 South Lanthrop Harvey, IL. 60426

| ALLOY | DESCRIPTION                    | NET LBS | PRICE     | AMOUNT      |
|-------|--------------------------------|---------|-----------|-------------|
| 8722  | 6000 SERIES FURNACE SCREENINGS | 33,564  | \$0.31500 | \$10,572.66 |

33,564

TOTAL DUE:

\$10,572.66

TERMS NET 30 DAYS COMMENTS:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359

INVOICE# (970905 CUSTOMER# \$1545 1358 CONTRACT# **VERBAL** 

INVOICE DATE (9/12/97) SHIPPED DATE 9/10/97 **PACKING LIST** 3908

SOLD TO:

Chemetco

16400 South Lanthrop Harvey, IL 60426

| ALLOY | DESCRIPTION                    | NET LBS | PRICE     | AMOUNT     |
|-------|--------------------------------|---------|-----------|------------|
| 8722  | 2000 SERIES FURNACE SCREENINGS | 31,328  | \$0.31500 | \$9,868.32 |

31,328

**TOTAL DUE:** 

\$9,868.32

TERMS NET 30 DAYS

COMMENTS:

PLEASE REMITTO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



970905

BOL#

1360

CONTRACT# **VERBAL** 

SOLD TO:

Chemetoo

16400 South Lanthrop Harvey, IL 60426

INVOICE DATE (

TO

9/16/97

SHIPPED DATE

**PACKING LIST** 

ALLOY

printed 0<del>6/01/2</del>011 11:04AM by Luttie.Boarman p. 333/361

DESCRIPTION

**NET LBS** 

PRICE

AMOUNT

8722

2000 SERIES FURNACE SCREENINGS

20,308

\$0.31500

\$6,397.02

20,308

TOTAL DUE:

\$6,397.02

TERMS NET 30 DAYS

COMMENTS:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359

## LIN BRASS - INDIANAPOLIS

## INDIANAPOLIS, INDIANA

BOL#

INVOICE # CUSTOMER # (\$1545

970908

CONTRACT#

**VERBAL** 

INVOICE DATE 9/25/97

SHIPPED DATE

9/19/97

PACKING LIST

3922

SOLD TO:

Chemetco

16400 South Lanthrop

Harvey, IL 60426

97 I 0508

| ALLOY | DESCRIPTION                    | NET LBS | PRICE     | AMOUNT      |
|-------|--------------------------------|---------|-----------|-------------|
| 8722  | 2000 SERIES FURNACE SCREENINGS | 34,194  | \$0.31500 | \$10,771.11 |

34,194

TOTAL DUE:

\$10,771.11

TERMS NET 30 DAYS

COMMENTS:

PLEASE REMIT TO:

**DLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



INVOICE # 970909 CUSTOMER # \$1545

BOL#
CONTRACT#

SOLD TO:

1368

VERBAL

Chemetoo

16400 South Lanthrop Harvey, IL 60426 INVOICE DATE 9/25/97
SHIPPED DATE 9/18/97
PACKING LIST 3919

97.I asog

| ALLOY | DESCRIPTION                    | NET LBS | PRICE     | AMOUNT      |
|-------|--------------------------------|---------|-----------|-------------|
| 8722  | 2000 SERIES FURNACE SCREENINGS | 33,216  | \$0.31500 | \$10,463.04 |

33,216

**TOTAL DUE:** 

\$10,463.04

TERMS NET 30 DAYS COMMENTS:

APPROVED BY:

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359



INVOICE # 970910 CUSTOMER # \$1545 BOL# 1369 CONTRACT# VERBAL SHIPPED DATE 9/18/97
PACKING LIST 3920

TO

SOLD TO:

printed 06/01/<del>261</del>1-1<del>1:0</del>4AM <del>by Luttie:Boarma</del>n p: <del>936/36</del>

Chemetoo

16400 South Lanthrop Harvey, IL 80426 97\_I US10

| ALLOY | DESCRIPTION                    | NET LBS | PRICE     | AMOUNT      |
|-------|--------------------------------|---------|-----------|-------------|
| 8722  | 3000 SERIES FURNACE SCREENINGS | 36,302  | \$0.31500 | \$11,435.13 |

36,302

TOTAL DUE:

\$11,435.13

TERMS NET 30 DAYS COMMENTS:

ADDROUGH OV.

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359



BOL#

CUSTOMER # (\$1545 1378

CONTRACT# **VERBAL** 

INVOICE DATE SHIPPED DATE 3929 **PACKING LIST** 

SOLD TO:

Chemetco 16400 South Lanthrop Harvey, IL 60426

97I0516

| ALLOY | DESCRIPTION                    | NET LBS | PRICE     | TRUOMA      |
|-------|--------------------------------|---------|-----------|-------------|
| 8722  | 2000 SERIES FURNACE SCREENINGS | 33,998  | \$0.31500 | \$10,709.37 |

33,998

**TOTAL DUE:** 

\$10,709.37

TERMS NET 30 DAYS

COMMENTS:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



# 3010VAI

CUSTOMER # BOL#

CONTRACT#

**VERBAL** 

Chemetoo SOLD TO:

> 16400 South Lanthrop Harvey, IL 60426

INVOICE DATE (9/29/97

SHIPPED DATE

9/23/97

**PACKING LIST** 

3928

97\_IOS17

| ALLOY | DESCRIPTION     | <br>NET LBS | PRICE     | AMOUNT      |
|-------|-----------------|-------------|-----------|-------------|
| 3538  | O.A. 3530 SCRAP | 40,122      | \$0.46000 | \$18,456.12 |

40,122

TOTAL DUE:

\$18,456.12

TERMS NET 30 DAYS COMMENTS:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



CUSTOMER# (\$1545

BOL#

SOLD TO:

1388 **VERBAL** 

CONTRACT#

Chemetco

16400 South Lanthrop

Harvey, IL 60426

INVOICE DATE (

SHIPPED DATE

10/3/97

PACKING LIST

3940

| ALLOY | DESCRIPTION                    | NET LBS | PRICE     | AMOUNT      |
|-------|--------------------------------|---------|-----------|-------------|
| 8722  | 3000 SERIES FURNACE SCREENINGS | 34,568  | \$0.31500 | \$10,888.92 |

34,568

TOTAL DUE:

\$10,888.92

TERMS NET 30 DAYS

COMMENTS:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



CUSTOMER# 51545

BOL#

1396

CONTRACT#

**VERBAL** 

SOLD TO:

Chemetco

18400 South Lanthrop Harvey, IL '60426

INVOICE DATE (10/15/97

SHIPPED DATE

10/09/97

PACKING LIST

3947

| ALLOY | DESCRIPTIÓN                    | NET LBS | PRICE     | AMOUNT      |
|-------|--------------------------------|---------|-----------|-------------|
| 8722  | 2000 SERIES FURNACE SCREENINGS | 34,180  | \$0.31500 | \$10,766.70 |

34,180

TOTAL DUE:

\$10,766.70

TERMS NET 30 DAYS COMMENTS:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



CUSTOMER # \$1545

BOL#

1395

CONTRACT# **VERBAL**  INVOICE DATE SHIPPED DATE 10/15/97 10/08/97

PACKING LIST

3946

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Chemetoo

16400 South Lanthrop Harvey, IL 60428

97 Jaso9

| ALLOY | DESCRIPTION                    | NET LBS | PRICE                  | AMOUNT      |
|-------|--------------------------------|---------|------------------------|-------------|
| 8722  | 3000 SERIES FURNACE SCREENINGS | 35,238  | \$0.31 <del>50</del> 0 | \$11,099.97 |

35,238

**TOTAL DUE:** 

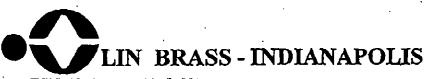
\$11,099.97

TERMS NET 30 DAYS COMMENTS:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



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INVOICE # 971011 CUSTOMER # 91545

BOL# CONTRACT# 1405

T# VERBAL

SOLD TO: Chemetco

16400 South Lanthrop Harvey, IL 60426 SHIPPED DATE 10/21/97
PACKING LIST 3957

9780511

| ALLOY | DESCRIPTION                    | NET LBS | PRICE     | AMOUNT      |
|-------|--------------------------------|---------|-----------|-------------|
| 8722  | 6000 SERIES FURNACE SCREENINGS | 32,304  | \$0.31500 | \$10,175.76 |

32,304

TOTAL DUE:

\$10,175.76

TERMS NET 30 DAYS COMMENTS:

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ADDONVED EV

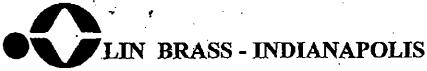
PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359

TQ

FINANCIAL



INDIANAPOLIS, INDIANA

INVOICE # 971012

CUSTOMER # \$1545 BOL#

CONTRACT# VERBAL

1408

Chemetco . SOLD TO:

16400 South Lanthrop Harvey, IL 60426

10/21/97 · INVOICE DATE ( SHIPPED DATE 10/17/97 3958 PACKING LIST

| ALLOY | DESCRIPTION                    | NET LBS | PRICE     | AMOUNT      |
|-------|--------------------------------|---------|-----------|-------------|
| 8722  | 3000 SERIES FURNACE SCREENINGS | 34,380  | \$0.31500 | \$10,829.70 |

34,380

TOTAL DUE:

\$10,829.70

RMS NET 30 DAYS

COMMENTS:

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359



CUSTOMER # (\$1545

BOL#

1426

CONTRACT# **VERBAL**  INVOICE DATE (10/30/97

SHIPPED DATE

10/27/97

**PACKING LIST** 

3981

SOLD TO:

Chemetco

16400 South Lanthrop Harvey, IL 60426

| ALLOY | DESCRIPTION                    | NET LBS | PRICE     | AMOUNT     |
|-------|--------------------------------|---------|-----------|------------|
| 8722  | 2000 SERIES FURNACE SCREENINGS | 26,214  | \$0.27000 | \$7,077.78 |
| 8722  | 6000 SERIES FURNACE SCREENINGS | 8,744   | \$0.27000 | \$2,360.88 |

34,958

TOTAL DUE:

\$9,438.66

TERMS NET 30 DAYS COMMENTS:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359

BOL#

971025

CUSTOMER # \$1545

CONTRACT#

1430

**VERBAL** 

SOLD TO:

Chemetoo

16400 South Lanthrop Harvey IL 60426

INVOICE DATE 10/30/97

SHIPPED DATE

10/26/97

PACKING LIST

3984

| <b>ALLO</b> Ý | DESCRIPTION                    | NET LBS | . PRICE   | AMOUNT             |
|---------------|--------------------------------|---------|-----------|--------------------|
| 8722          | 2000 SERIES FURNACE SCREENINGS | 24.000  | An areas  | 40,000,74          |
| 9144          | ZUVU GERIEG FURNALE SCREENINGS | 34.662  | \$0.27000 | \$0.359.7 <i>A</i> |

34,662

TOTAL DUE:

\$9,358.74

TERMS NET 30 DAYS COMMENTS:

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359

INVOICE # 971028

BOL#

CONTRACT#

**VERBAL** 

SOLD TO:

Chemetoo

16400 South Lanthrop

Harvey, IL 60426

INVOICE DATE -41/3/97

SHIPPED DATE 10/30/97

PACKING LIST

3991

| ALLOY | DESCRIPTION                    | NET LBS | PRICE     | AMOUNT     |
|-------|--------------------------------|---------|-----------|------------|
| 8722  | 2000 SERIES FURNACE SCREENINGS | 32,888  | \$0.27000 | \$8,879.76 |

32,888

TOTAL DUE:

\$8,879.76

TERMS NET 30 DAYS COMMENTS:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



INVOICE #

BQU#

CONTRACT# VERBAL INVOICE DATE (10/31/97)

SHIPPED DATE

10/29/97

**PACKING LIST** 3988

SOLD TO:

Chemetoo

16400 South Lanthrop

1433

Harvey, IL 60426

ALLOY DESCRIPTION **NET LBS** 

PRICE

**AMOUNT** 

8722

3000 SERIES FURNACE SCREENINGS

33,372

\$0.27000

\$9,010.44

33,372

TOTAL DUE:

\$9,010.44

TERMS NET 30 DAYS COMMENTS:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



INVOICE # 971028 CUSTOMER# (\$1545)

BOL# CONTRACT#

1404 VERBAL INVOICE DATE (10/20/97) SHIPPED DATE

**PACKING LIST** 

3954

SOLD TO:

Chemetco

16400 South Lanthrop Harvey, IL 60426

| ALLOY | DESCRIPTION                    | NET LBS | PRICE     | AMOUNT      |
|-------|--------------------------------|---------|-----------|-------------|
| 8722  | 3000 SERIES FURNACE SCREENINGS | 35,324  | \$0.30000 | \$10,597.20 |

35,324

**TOTAL DUE:** 

\$10,597.20

TERMS NET 30 DAYS **COMMENTS:** 

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359

FINANCIAL



INVOICE # 971122 CUSTOMER # \$1545 BOL# 1469

CONTRACT# VERBAL

SOLD TO: Chemetoo

16400 South Lanthrop Harvey, IL 60426 INVOICE DATE 12/02/97
SHIPPED DATE 11/25/97
PACKING LIST 4030

97K0524

| ALLOY | DESCRIPTION     | net LBs | PRICE     | AMOUNT      |
|-------|-----------------|---------|-----------|-------------|
| 3538  | O.A. 3530 SCRAP | 36,758  | \$0.31000 | \$11,394,98 |

36,758

TOTAL DUE:

\$11,394.98

TERMS NET 30 DAYS COMMENTS:

460001F0 0W

PLEASE REMIT TO:

OLIN BRASS-INDIANAPOLIS

P.O. BOX 92359

DEC-23-1997 08:42 FROM



. 70

INVOICE#

971208

CUSTOMER# \$1545

1484 VERBAL

CONTRACT#

SHIPPED DATE

12/18/97

PACKING LIST

4045

270

SOLD TO:

Chemetoo

16400 South Lanthrop

Harvey, IL 60426

9750507

ALLOY

DESCRIPTION

NET LBS

PRICE

**AMOUNT** 

6428

O.A. 6428 CUTS

5,862

\$0.59150

\$3,467.37

5,862

TOTAL DUE:

\$3,467.37

ERMS NET 30 DAYS

COMMENTS:

APPROVED BY:

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359



971209

CUSTOMER # \$1545

BOLS

1484

CONTRACT# VERBAL

80LD TO:

Chemetco

16400 South Lanthrop Harvey, IL 60426.

INVOICE DATE

12/18/97

SHIPPED DATE

12/11/97

**PACKING LIST** 

4044

9700508

**ALLOY** DESCRIPTION **NET LBS** 

PRICE

AMOUNT

6558 O.A. 6550 CUTS 34,322

\$0.62400

\$21,416.93

34,322

**TOTAL DUE:** 

\$21,416.93

ERMS NET 30 DAYS

COMMENTS:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



971210 CUSTOMER# (\$1545

BOL#

SOLD TO:

CONTRACT#

VERBAL

1483

Chemetoo

16400 South Lanthrop Harvey, IL 60426

INVOICE DATE

SHIPPED DATE PACKING LIST

4043

97.0509

| ALLOY | DESCRIPTION                    | NET LBS | PRICE     | AMOUNT     |
|-------|--------------------------------|---------|-----------|------------|
| 8722  | 6000 SERIES FURNACE SCREENINGS | 35,628  | \$0.24750 | \$8,817.93 |

35,628

TOTAL DUE:

RMS NET 30 DAYS

COMMENTS:

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359



CONTRACT#

DEC-23-1997 16:37 FROM

SHIPPED DATE **PACKING LIST** 

INVOICE DATE

TO

(12/23/97) 4047

SOLD TO:

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Chemetoo

16400 South Lanthrop Harvey, IL 60426

7213.07

972/05/-

| ALLOY | DESCRIPTION    | NET LBS | PRICE     | - | AMOUNT      |
|-------|----------------|---------|-----------|---|-------------|
| 6490  | O.A. 6490 CUTS | 20,228  | \$0.65960 |   | \$13,342.39 |

OLIN ACCOUNTING INDPLS

20,228

**TOTAL DUE:** 

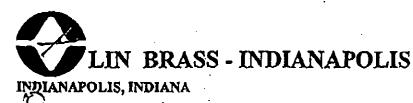
\$13,342.39

TERMS NET 30 DAYS COMMENTS:

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359



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INVOICE # 971214 CUSTOMER # 61545 BOL# 1486

CONTRACT#

1486 7213.05

SOLD TO:

Chemetoo

16400 South Lanthrop Harvey, IL 60426 INVOICE DATE 12/23/97
SHIPPED DATE 12/12/97
PACKING LIST 4048

9780513

| ALLOY | DESCRIPTION    | NETLBS | PRICE     | AMOUNT      |
|-------|----------------|--------|-----------|-------------|
| 6428  | O.A. 6420 CUTS | 19,318 | \$0.59150 | \$11,426.60 |

19,318

TOTAL DUE:

\$11,426.60

SAMS NET 30 DAYS COMMENTS:

APPROVED BY:

PLEASE REMIT TOP

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359

CHICAGO, IL 60675-2359

TOTAL P A:



INVOICE # 971215 CUSTOMER # \$1545 BOL# 1488 CONTRACT# 7213.01

DEC-23-1997 16:33 FROM

SHIPPED DATE
PACKING LIST

12/23/97 12/12/97 4049

CONTRACT#

SOLD TO:

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Chemetoo

16400 South Lanthrop Harvey, IL 60426 9750514

| ALLOY | DESCRIPTION    | NET LBS | PRICE     |          | AMOUNT     |
|-------|----------------|---------|-----------|----------|------------|
| 1458  | O.A. 1450 CUTS | 8,278   | \$0.64350 | <u>-</u> | \$5,326.89 |

DLIN ACCOUNTING INDPLS

8,278

TOTAL DUE:

\$5,326.89

TERMS NET 30 DAYS COMMENTS:

APPROVED BY:

PLEASE REMIT TO:
OLIN BRASS - INDIANAPOLIS
P.O. BOX 92359
CHICAGO, IL 60875-2359



CUSTOMER # (\$1545

BOL#

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1488

7213.05

CONTRACT#

Chemetoo

16400 South Lanthrop

Harvey, IL 60426

INVOICE DATE

SHIPPED DATE

12/12/97

PACKING LIST

4050

9720515

| ALLOY | DESCRIPTION    | <br>NET LBS | PRICE     | AMOUNT     |
|-------|----------------|-------------|-----------|------------|
| 6428  | O.A. 6420 CUTS | 7,780       | \$0.59150 | \$4,601.87 |

7,780

**TOTAL DUE:** 

\$4,601.87

TERMS NET 30 DAYS COMMENTS:

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359



CUSTOMER # (S1545) BOL#

1488

CONTRACT#

SOLD TO:

72130.7

Chemetco 16400 South Lanthrop Harvey, IL 60426

INVOICE DATE

12/23/97

SHIPPED DATE **PACKING LIST** 

4051

9780516

| ALLOY | DESCRIPTION    | NET LBS | PRICE     | THUOMA      |
|-------|----------------|---------|-----------|-------------|
| 6490  | O.A. 6468 CUTS | 22,128  | \$0.65960 | \$14,595.63 |

22,128

**TOTAL DUE:** 

\$14,595.63

TERMS NET 30 DAYS

COMMENTS:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



INVOICE &

BOL#

CUSTOMER # (\$1545

CONTRACT#

1491

7213.05

Chemetco SOLD TO:

16400 South Lanthrop

Harvey, IL 60426

INVOICE DATE (

SHIPPED DATE

12/23/97 12/15/97

**PACKING LIST** 

4055

9720518

ALLOY

DESCRIPTION

**NET LBS** 

PRICE

AMOUNT

6428

O.A. 6420 CUTS

38,452

\$0.59150

· \$22,744,36

38,452

**TOTAL DUE:** 

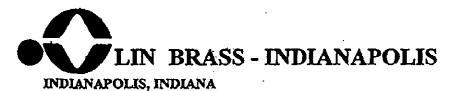
\$22,744,36

TERMS NET 30 DAYS COMMENTS:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



CUSTOMER # (\$1545 BOL#

1492

CONTRACT#

SOLD TO:

7213.05

Chemetco

16400 South Lanthrop

Harvey, IL 60426

INVOICE DATE

TO

SHIPPED DATE

**PACKING LIST** 

4056

9720519

| ALLOY | DESCRIPTION    | NET LBS | PRICE     | AMOUNT     |
|-------|----------------|---------|-----------|------------|
| 6428  | O.A. 6420 CUTS | 13,926  | \$0.59150 | \$8,237.23 |

13,926

**TOTAL DUE:** 

\$8,237,23

TERMS NET 30 DAYS

COMMENTS:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



INVOICE DATE

12/23/97

CUSTOMER# (\$1545 BOL#

1492

SHIPPED DATE

12/15/97

CONTRACT#

7213.01

**PACKING LIST** 

4057

SOLD TO:

Chemetco

16400 South Lanthrop

Harvey, IL 60426

9720520

| ALLOY | DESCRIPTION    | NET LBS | PRICE     | AMOUNT     |
|-------|----------------|---------|-----------|------------|
| 1458  | O.A. 1450 CUTS | 13,808  | \$0.64350 | \$8,885.45 |

13,808

TOTAL DUE:

\$8,885.45

TERMS NET 30 DAYS COMMENTS:

PLEASE REMIT TO:

**OLIN BRASS - INDIANAPOLIS** 

P.O. BOX 92359



INVOICE # 971222 CUSTOMER # \$1545 BOL# 1492

INVOICE DATE SHIPPED DATE PACKING LIST

12/23/97 12/15/97 4058

CONTRACT#

7213.06

SOLD TO:

Chemetoo

16400 South Lanthrop Harvey, IL 60426

9720521

| ALLOY | DESCRIPTION    | NET LES | PRICE     | THUOMA     |
|-------|----------------|---------|-----------|------------|
| 6558  | O.A. 6550 CUTS | 8,684   | \$0.62400 | \$5,418.82 |

8,684

TOTAL DUE:

\$5,418,82

TERMS NET 30 DAYS COMMENTS:

APPROVED RY

PLEASE REMIT TO:

OLIN BRASS - INDIANAPOLIS

P.O. BOX 92359